ELECTRICAL REVIEW

ILLUSTRATED.

A WEEKLY JOURNAL OF

Electric Light, Power, Telephone, Telegraph and Scientific Progress.

VOL. 20. No. 22. WEEKLY.

NEW YORK, SATURDAY, JULY 23, 1892.

$3 per Annum. Single Copies, 10 Cents.

Copyright, 1892, by ELECTRICAL REVIEW PUBLISHING COMPANY, 13 Park Row, New York.

Entered at Post Office, New York, as Mail Matter of the Second Class.

VIEWS, NEWS AND INTERVIEWS.

"Why don't you have electric fans and incandescent lights in this place?" asked a perspiring customer as he sweltered in a chair in the barber shop of a down-town New York hotel.

"Don't dare to," said the barber. "If we had those conveniences here, the guests of the hotel would kick for electric fans and lights in the lobby, in the dining-room and all over the house. The proprietor of the hotel won't spend the money to do this, and that's why our customers have to sit here and perspire."

"A valuable aid to my teaching," said Prof. George D. Shepardson, of the University of Minnesota, at Minneapolis, "is the Journal Club which we have formed in the electrical department. Each student is given one of the electrical papers to read and digest. When the Club meets at the end of the week each man makes a report on what he has read that is new or progressive in the electrical field. A general discussion follows."

The generators that George Westinghouse is building to furnish electricity for the 93,000 incandescent lamps at the World's Fair are to be among the largest in the world. One of them will operate 20,000 lamps. "The ordinary generator supplies but 1,200 lamps," Mr. Westinghouse said, "and most of them less. Our largest generator will supply 20,000 lamps, and most of the others will be of 10,000 lamp capacity each."

It is understood that Austin Corbin's big electrically illuminated sign at Broadway and Fifth avenue, which was illustrated and described in the ELECTRICAL REVIEW last week, cost $20,000 to build and put up. It is said that $9,000 rental is paid for the wall on which the sign is placed. In addition to this the sign requires about 700 amperes of current for four hours every night. Counting attendance, lamp renewals and incidentals, it costs Mr. Corbin about $75 per night to make the most brilliant out-door electrical display in New York. It is pretty expensive advertising, but it is truly progressive.

Another beautiful aurora borealis was visible in New York city about 10 o'clock last Saturday night. Although the sky was clear and the stars were shining the quivering beams and flashes of light were strongly evident. For about an hour telegraph messages for the West were received subject to delay, as the wires were extremely cantankerous.

The eighteenth exhibition of the Massachusetts Charitable Mechanic Association, to be held in Boston in October and November, bids fair to excel anything of the kind ever held in New England. A system has been arranged whereby the exhibits will be in groups according to their character. The electrical exhibit will excel anything of the kind ever held before. A novelty will be a display of a complete electrical equipment for mines. There will be ample power for running all kinds of machinery and the building will be thoroughly lighted by the new electric plant which has recently been installed. There will be no dingy spots as heretofore. The plant has a capacity of 2,000 incandescent lights and 150 arcs, and is capable of running considerable machinery by electric power.

A Cyclone's Visit to a Telephone Exchange.

Our readers will remember the terrible cyclone which tore through Kansas on May 27, 1892. The principal force of the cyclone was felt at Wellington, Kansas, which town was nearly destroyed. Mr. C. W. McDaniel, superintendent of the Missouri & Kansas Telephone Company, has forwarded to the ELECTRICAL REVIEW some photographs which he made of the wreck at Wellington after the cyclone had passed. The illustration on this page is reproduced from one of Mr. McDaniel's pictures, and shows the interior of the telephone exchange at Wellington. Miss Harp, the operator in charge of the exchange, escaped instant death only by a few seconds. She had just arisen from the chair which, in the picture, is seen to be filled with brick and mortar, and stepped to the counter to speak to a caller when the bricks from an adjoining wall fell in. In others of the pictures which Mr. McDaniel has sent us is seen that all the pole lines belonging to the telephone company were snapped off short, showing with what tremendous force the cyclone attacked whatever stood in its path. We, who live in the East, have but very little idea of the immense damage done by these high winds in the West, but the picture shown herewith will give a faint suggestion of what our western telephone brethren have to contend with.

THE TELEPHONE EXCHANGE AT WELLINGTON, KANSAS, AFTER THE CYCLONE OF MAY 27TH, 1892.—FROM A PHOTOGRAPH BY MR. C. W. MCDANIEL.

The Canadian Niagara Power Company.

A dispatch from Niagara Falls, N. Y., under date of July 16, says:

The Canadian Niagara Power Company, to develop the power of the Horseshoe Falls, in Victoria Park, was formally organized to-day at a meeting held at the Clifton House. There were present Col. Albert B. Shaw, Francis L. Stetson and William D. Rankine, of New York, and John D. Irwin, John G. Scott and C. J. Elliot, of Toronto. These officers were elected: President, Col. A. D. Shaw; vice-president, F. L. Stetson; secretary and treasurer, W. B. Rankine. The lease of the exclusive privileges to develop the power of the falls in Victoria Park, which was granted to Messrs. Shaw, Stetson and Rankine by the Park Commissioners, was duly transferred to the newly organized company. Col. Shaw says that they will await the completion of the tunnel on this side before commencing operations in Canada.

Telephone Cables in the North River.

The Metropolitan Telephone and Telegraph Company is putting down two large cables for connecting New York city with the Jersey coast. Each of these cables is 5,300 feet in length, 18 conductors, and are laid from the foot of Vesey street, New York, across the Hudson river to Hoboken, N. J. Both cables were manufactured by the Kerite Company, and are similar to the one the laying of which was illustrated and described in a recent issue of the ELECTRICAL REVIEW. The constant increase of heavy telephonic work shows the demand growing out of long distance telephony, as we understand that most of this new cable work is for this service.

We learn that very extensive orders for hard drawn copper wire have recently been placed by the telephone interests for the extension of the lines to Chicago, and it is hoped that communication with that city and the East will be open by the date of the dedicatory services of the World's Columbian Exposition to be held October next at Chicago.

Can't Steal Electricity.

Gustave Temple, the first man tried on a charge of stealing electricity, has been discharged from the Court of Criminal Correction at St. Louis by Judge Claiborne. The judge would not concede that the offense was petit larceny and the Grand Jury would not allow that it was fraud, so when the case came up recently Attorney McDonald, for Temple, entered a plea for formal acquittal, which was concurred in, and the defendant was discharged. Temple, who is a hardware dealer, was accused of having tapped a wire of one of the electric light companies to get his illumination free.

The fight between the subscribers and the Potomac Telephone Company, at Baltimore, Md., has been carried into the courts. Judge Wright granted an injunction restraining the company from putting in force a scheme to evade the law passed at the last Legislature. Nothing is now left the company but to test the constitutionality of the act.

LIGHT AND POWER STATIONS.

SOME HINTS TO OWNERS AND OPERATORS BY A PRACTICAL ENGINEER.

How Dividends May be Made—The Manufacturer, the Agent, the Expert, and the Responsibility of Each—It Pays to Employ Supervising Engineers of Standing—Views of an Observing and Experienced Man.

BY ROBB MACKIE.

In an experience covering a number of years I have many times been asked the question, "Why doesn't this station pay?" and in seeking for an answer, almost without exception, I found upon a close examination that the entire fault lay with the owners of the plant.

At the outset this will strike the average reader as too broad an assertion, but I hope to prove its accuracy before I have done with the subject, and if the eyes of any owners are opened to present abuses in the method of operating their plants, or if any newer seekers after the dollars of the public, who may be contemplating an investment in some one of the fields of electrical transmission of light or power, are led to revise their plans upon a better business basis, and thereby even one more station is added to the present list of paying electrical investments, my time in writing will have been well spent.

There was "malice aforethought" in the statement that the *entire* fault lies at the door of the investor, for while they will be tempted to resent this slur cast upon them, there is every reason to believe they realize its truth, when they, to garble a quotation, "look for the dividends which never come."

As surely as in business life the principal is held responsible for the acts of his agent, so surely must the owners of an electrical plant be held responsible for its failure to make a return upon the investment; for while the owners may have been misled at the time of purchasing the plant, or the men whom they have operating it may through ignorance or carelessness be directly the cause of the poor running and poor returns, the owners are the ones who are directly responsible for retaining these methods and men in the positions they occupy, and therefore are "aiding in their own undoing."

I fear that many owners reading this will claim they have only done what the agent of the company selling the plant, or the "expert" who installed it instructed them to do. In this I regret to say, "they have reason," as our French brothers would say, for the facts of their complaints are too often a sad commentary upon the veracity of the agent who sold the plant.

But in one thing the owners can take comfort, for in numerous cases there are plants owned and operated by the manufacturing companies themselves, which are in no better condition to-day than the ones they have disposed of.

This may seem a strange condition of affairs, but the writer knows of a number of plants owned and operated to-day by the

manufacturing companies that are the embodiment of poor electrical and mechanical engineering.

Why this condition of affairs should be allowed to continue has long been a source of wonder to many, yet the facts remain; and year after year these plants which should be the models of good engineering, management and profits are continued in operation under conditions far from model, unless it be a model for a junk heap.

It certainly is deeply to be regretted that so many plants have been sold upon representations so very far removed from the stern, cold, realistic facts, by the agent on the one hand, and installed by the so-called "expert" on the other, who, to judge by his work, was ignorant of the first elements of his business, without which no man can do thoroughly first-class work.

The conditions existing in plants, both large and small, throughout the length and breadth of the land are, when carefully weighed by the thinking man interested in the successful and widest development of the electrical industries, appalling indeed. Poor designs and poorer workmanship are the rule rather than the exception, and the train of evils which follows upon this "cheap John" policy are the foundation stones upon which has been built up the hue and cry throughout the land for the "burying of the wires underground."

Many plants to-day are in a condition actually dangerous to life and property, and through ignorance on the part of the men operating the plants, and the owners themselves, and even the city and State officers who should, of all others, know better. On and on they go until an "accident" happens, resulting in the death of one or more persons.

Of course, no one is to blame except the poor chap who is dead! But if the truth were brought out it would be shown that the line so indelibly impressed upon our school boy minds, "Some one had blundered," was still a living issue and had not died amid the cannon shouts about which we used to declaim in such a dramatic way.

Some of the manufacturing companies, through carelessness or cupidity, have aided and abetted in this cheap construction to an extent that can hardly be realized by those unfamiliar with the actual physical condition of the plants throughout the many cities and towns of this country, and to-day, those who purchased these plants in good faith, accepting as "gospel truth" the statements of the agents, are suffering because in the effort to secure the sale, such low prices were quoted that it was impossible to do decent work or place a competent man on the ground to install the plant and still have any profit to charge up against the sale.

These are the days when we begin to see some of the "chicks come home to roost," and these same "chicks" are of a nature to cause us to pause and wonder what the final result will be if the same headlong, haphazard policy, or rather lack of policy, is followed in the future that has obtained the millions of dollars of investment in electrical enterprises in the past. The burning questions which require careful study on the part of the two sides interested are:

Is the manufacturer doing all he should to advance on a sound basis, both engineering and financial, this wonderful industry that has sprung into such strong life in so short a time?

And, on the other hand, has the purchaser gained by the experiences of the past, and does he take all necessary precautions to hold the contractors to their contracts and to see that only the best work is done?

These are hard questions to answer in these days, but there are many indications confirming one in the belief that there is much improvement in the workmanship being done; on the other hand, there is too much work being done to-day in charge of incompetent men, and this same story of "cheap John" work will continue to be told just so long as the purchasers continue to listen only to one side of the argument, and continue to place such absolute confidence in the men from whom they purchase, as they have done in the past.

The experience of those who have bought lighting plants is even now being repeated in many cities of the country in the purchase of railway installations, and will be repeated in those to be made of stationary motors and in the newer and vaster fields of mining and agricultural work, unless far greater care be exercised by the purchaser of the future than has been exercised in the past.

It is not the purpose of these papers to make the broad, sweeping assertions that all the plants sold and installed have been disposed of, on the one hand, by unprincipled manufacturers aided by unscrupulous agents, and, on the other hand, installed by expertless "experts," nor to warn the purchaser against all of these gentlemen who may visit them, but rather to point out in plain, vigorous terms the dangers that lie in the way, and to show that, for the reputable manufacturer and all connected with his side, as well as for the purchaser and all on his side, the safest way is to have the work supervised, on the part of the latter, by an engineer of unquestioned standing and ability. By following this course the purchaser is assured of obtaining full value for his money, and the reputable manufacturer knows that only first class work will be allowed. This means a first class price and the driving to the wall of concerns doing cheap work for cheap prices, and the bringing up the standard of work to the necessities of first class engineering.

(To be Continued.)

A New Electric Tower Clock.

We illustrate the new electric tower clock of the Standard Electric Time Company, of New Haven, Conn., which has recently been put on the market by that company, and which is quite a departure from the usual means of operating tower clocks.

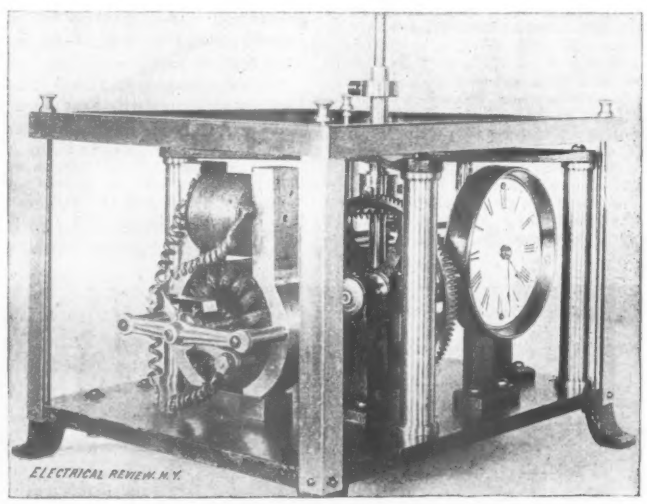
This one is operated by an electric motor with suitable gearing, and so arranged to be controlled by a self-winding regulator which starts the motor in operation once every minute. After the motor has carried the hands just one minute, it breaks the circuit automatically, allowing the hands to rest at this point until the next minute is completed, when the same thing is repeated.

The arrangement of the mechanism is so positive that there is no possibility of a variation from the correct time given by the master clock.

The ordinary tower clock is operated by weights, and the movement being exposed to the extremes of temperature cannot possibly keep such good time as a clock that is finely adjusted and placed in a room where the temperature is more uniform. Besides, the ordinary tower clock must be wound up every week, which requires the full strength of one man, while the electric tower clock never requires winding.

One of the very important features about this clock is the operation of the motor by open circuit batteries. This has required a great many experiments by the Time Company to arrange a motor in such a way that the battery would stand the work, and it is sufficient to say that from 10 to 15 cells of open circuit battery will drive the motor moving the hands to this clock for at least one year without any attention whatever. And it will deliver more power to the hands than the ordinary tower clock will with its heavy weights.

This company has just shipped one of these tower clocks to Newport News, Va., where it is to be placed in the new depot of the Chesapeake & Ohio Railway Company. Dials will also be placed in the waiting rooms, so that uniform time will be given throughout the building. One of these tower clocks has been in operation during the past winter and was not interrupted by any of the storms, while other tower clocks were motionless.



A New Electric Tower Clock.

The Clam Crop is Ripe and will be Harvested.

It is extremely thoughtful and generous of President Eugene F. Phillips, of the American Electrical Works, Providence, to send out his invitations for his annual clam bake a couple of weeks in advance. The electrical fraternity thus obtains an opportunity of going into training for the clam contest.

The fourteenth annual clam bake tendered by the American Electrical Works to the fraternity will be demolished at Haute Rieve, the country house of the Union Club, near Providence, on Saturday, July 23. A lunch will be served at 11.30 A. M. for those of abnormal appetites. Most people will save their capacities for the regular bake, which opens at 2 P. M. and closes when the clams or the guests give out. A well known New York sporting man has $10,000 to bet at odds of ten to one that the guests will give out first.

Two committees have been appointed, as follows: Honorary Committee—A. C. White, Providence; E. D. Floyd, Boston; A. D. Newton, Windsor; John I. Sabin, San Francisco; Lemuel Bannister, Pittsburgh; H. F. Woods, Boston; E. B. Baker, New Haven; J. I. Ayer, St. Louis.

Reception Committee—W. A. Hathaway, E. Rowland Phillips, W. H. Sawyer, C. H. Wagensell, C. R. Remington, Jr., A. L. Capper, P. C. Ackerman, John Carroll.

The honorary fellows will wear badges and the reception gentlemen will wear smiles. President Phillips could provide an interesting feature by having a clam eating contest between these two committees—after everybody else has had their clams.

Philadelphia Telephone Rates Reduced.

The Bell Telephone Company, of Philadelphia, announced last week that it would reduce the rate in the old city proper to $120 per year. Dr. Plush, the president, said that the company intends to have the same rate throughout the city as soon as possible. The present reduction will affect about 250 subscribers. "It has been our intention," said Dr. Plush, "as soon as the underground system was completed and the wires properly connected, to make a uniform exchange rate in the old city proper—the territory covered by the ordinance of 1888. As that work is nearing completion the company has decided to let the new rate go into effect from July 1."

Getting the Worth of One's Money in Advertising.

BY EDWARD A. OLDHAM IN "PRINTER'S INK."

I once heard of a grasping old codger down in Maine who informed the public, through his advertisement in the local newspaper, that he dealt in dry and fancy goods, boots and shoes, groceries, grain, feed, crockery and hardware; that he kept the post office, was the justice of the peace, was a conveyancer, was agent of an insurance company, ran a set of hay scales, had "ice cool soda and other cool drinks," had famous ten and five cent cigars, was agent for a fertilizer and furnished aristocratic eggs for putting under aristocratic hens. If all these items had not exhausted the limited space he had contracted for, he would doubtless have added a few other departments of his multifarious stock.

This instance is cited by way of illustrating the prevalent habit advertisers have of making their advertising space go further than practical common sense would dictate. It is a species of penny wisdom and pound foolishness that has produced a crop of unsatisfactory results for the advertiser, and has caused him to jump to the conclusion that money spent for advertising is money wasted.

All publishers in the small cities and towns of the country are unfortunately too familiar with this condition of things, and they are the ones to welcome any medium that will educate the advertiser regarding the most effective and intelligent way to fill up his space.

I believe it may be safely declared that more harm has been done the cause of advertising by these greedy space fillers than by any other single influence, and it behooves the publishers of the country to correct this abuse as rapidly as possible.

Such advertisements not only are not read by a large percentage of the paper's readers, but are positive eyesores to the paper itself, marring what typographical beauty the foreman may have brought into play. I have seen a handsomely printed paper, with great taste displayed in the classification of reading matter, the construction of "horse heads," the arrangement of dashes, etc., but the advertising columns were a disgrace to the sheet. The foreman was not responsible. He was like the man with a No. 8 head, who was compelled to wear a No. 5 hat. The advertisers *would* send in "copy" that so entirely filled their contract space as to leave the poor fellow absolutely no room into which to display his typographical taste, and many times he was compelled to eliminate portions of the copy with the absolute assurance that the advertiser—who never read his own advertisement—would not discover the omission.

These things should not be. There should be no paper, however humble, that should not have a uniform standing for advertisements, and to try earnestly to live up to it. First of all, advertising patrons should be educated as to the limit of matter that is to be contained in a given space, or else the foreman should be given *carte blanche* to set up the notice attractively, let it occupy as much space as it will. The more prosperous journals can insist on an observance of this rule; all the others can do is to adopt an educational policy and fight it out along that line.

An advertisement is attractive to the eye in such ratio as there is contrast visible. A business notice set in compact form, with no chance for display or no contrast of white space around it or in it, is no notice at all, and few there be who trouble themselves to read it.

But, on the other hand, a space not overrun with matter, and this trick of contrast being studiously observed, will attract the eye, no matter how small the space may be. In a limited space it is never well to enumerate too many lines, especially—as in the case of grocers and dry-goods merchants—each line is capable of many subdivisions. This is an age of details, and the successful advertiser must not overlook this fact. His prospective patrons will not; and, instead of doing like the Maine man—crowding his entire stock into limited space—he had better make a new contract for greater space or confine the small space to one article this week and another next

The Worcester and Millbury Street Railway Company.

The Worcester and Millbury, Mass., Street Railway Company is actively pushing all the various branches of the construction of its road. The power station, which will be of brick, 50x100 feet, is well under way and will be completed, suitable to receive machinery, probably by July 15. The car house, which is of wood, 50x150 feet, is also well under way and will be ready to receive cars by the middle of July.

The steam plant will consist of 250 horse-power, tandem compound condensing engines of the Armington & Sims pattern, belted direct to the dynamos. These engines are being built after special design, and specially adapted to heavy strain of railway work. There will be three 150 horse-power boilers, pumps, heaters, condensers, etc., all of which will be of the most approved and latest pattern, from designs furnished by Mr. H. C. Patterson, chief engineer of the Thomson-Houston Electric Company of Boston. The condensers will be operated under what is known as the gravity system, the railway company having sufficient head of water to allow this to be done. Each engine will have separate condenser of its own.

The electrical equipment will consist of sixteen 25 horse-power motors, two 150 horse-power generators, together with all the necessary station equipment, which are to be furnished by the Thomson-Houston Electric Company, of Boston.

The cars will be furnished by the Newburyport Car Company, of Newburyport, Mass. There will be eight open and eight box cars. There will also be two snow plows, which latter will probably not be delivered until late in the Fall.

The company has made an exceptionally favorable purchase of a large mill property, situated half-way between Worcester and Millbury, which has 45 acres of land, some 100 horse-power in water, together with 21 tenement houses.

The entire length of the road will be seven and one-half miles.

Fifty pound T rail will be used in this construction.

This property is looked upon as one of great promise.

The president of the company is ex-Mayor Samuel Winslow, of Worcester, Mass., and the treasurer is Thomas T. Robinson, of Dedham, Mass. These two gentlemen are also the president and treasurer of the Worcester, Leicester and Spencer Street Railway Company, which road was promoted by Mr. Robinson, as was also the Millbury road.

The stock of the Worcester, Leicester and Spencer Road now sells, it is said, at $140 per share. The net earnings for the month of May will exceed at the rate of 12 per cent. per annum of its capital stock. The Worcester and Millbury road is pronounced by good judges to be capable of earning more money on its investment, and holders of this stock, although only 50 per cent. of the same has been paid in, desire considerable above par when asked to sell.

Homestead Strikers Rent the Whistle.

The impression has gone abroad that the Homestead, Pa., electric light whistle, which played such a prominent part in affairs at Homestead since the beginning of the trouble there, has been voluntarily used by the electric light people as a means of warning the locked out workmen of the approach of Pinkerton men or others to take possession of the Carnegie plant, says the Pittsburgh *Times*. Superintendent McVey, of the electric light works, was spoken to yesterday regarding the matter. He said:

"The Amalgamated Association pays for the use of the whistle and controls it absolutely. When they desire to use it they come to the works, exhibit the official seal of the order, and are then given the small wheel with which the whistle is operated. Without this wheel the whistle cannot be blown. We have nothing at all to do with the blowing of the whistle. We simply see to it that no one without authority blows the whistle."

Electric Launches for the World's Fair.

At the official test of electric launches recently made by the electrical engineers of the World's Columbian Exposition, at Jackson Park, Chicago, Ill., each boat was required to make a 10 hour's consecutive run, over a prescribed course, and making designated landings.

Two boats entered, the "Electra," owned by the Electric Launch and Navigation Company, of New York, and a boat built by the Columbian Launch Company, of Chicago.

The "Electra" made 45 trips at the rate of 11¼ minutes per trip. The Columbian boat made 32 trips at the rate of 16¼ minutes per trip.

Subsequently, a test of several cells of battery taken at random from the two boats was had. The cells were charged as fully as the contestants desired and then discharged at the uniform rate of 16 amperes. The batteries of the "Electra" were charged 160 ampere hours, and gave a discharge of 137. The Columbian batteries were charged 200 ampere hours, and gave out 100. A second test of the latter resulted, charge, 235, discharge, 109.

Death of Cyrus West Field.

Cyrus W. Field died at 9.45 A. M., July 12, at his country home, Ardsley, at Irvington-on-the-Hudson. His death was painless and free from delirium. Although Mr. Field has been ailing for some time past, his death was not expected so soon. His immediate family were sufficiently alarmed about him, however, to be present at his bedside.

Funeral services were held at Irvington on July 14, after which the remains were sent to Stockbridge, Mass., where the interment was made. The funeral was largely attended by prominent people from near and far.

Cyrus West Field was born in Stockbridge, Mass., on November 30, 1819, and was the third son of David Dudley Field, a clergyman. He had three brothers, David Dudley, the distinguished jurist, Stephen J., justice of the Supreme Court of the United States, and Henry M., editor of the *Evangelist*. Although his three brothers were sent to college his father's lack of means prevented his sending Cyrus there. His early education was obtained in the local academy and by reading. At the age of 15 he decided to come to New York. Through his brother's influence he obtained a place with A. T. Stewart, which he retained for several years. In 1840 he went into partnership with E. Root, on Maiden Lane. The day after he attained his majority he married Miss Mary Bryan Stone, of Guilford, Conn. In 1841 Mr. Field's firm became bankrupt, but he arranged with his creditors and started in business for himself. In 12 years Mr. Field had amassed a large fortune and retired from business. At this time Mr. F. E. Church, the artist, and Mr. Field made a year's tour through South America.

Mr. Field's fame rests upon the laying of the Atlantic cable, an historical fact which is familiar to every school-boy. The credit for the idea of an Atlantic cable is conceded to Frederick N. Gisborne, a telegraph operator, but to Mr. Field belonged the credit for rendering this possibility a practicability and planning the ways and means. Mr. Field associated with himself in this project Peter Cooper, Moses Taylor, Marshall O. Roberts and Chandler Waite, all of whom agreed to give their financial support to the enterprise. A company was organized, known as the New York, Newfoundland and London Telegraph Company. The trials and suspenses, the vicissitudes and failures during 13 long years, when various attempts were made to lay the cable, are matters of history. After several unsuccessful attempts communication was established first in 1858. Four hundred messages were sent, and then the cable parted. Mr. Field again went to England in 1859 to make preparations for another attempt to lay the cable. The company had a nominal addition of $1,750,000. Mr. Field himself subscribed $440,000, Great Britain granted an annual subsidy of $70,000 and the United States granted $70,000 for 25 years. Both governments gave the use of ships of war in laying the cable. In 1866 the final and successful attempt was made. On July 27 when the feat was finished Congress voted Mr. Field a gold medal and the thanks of the country. John Bright in Parliament called him "the Columbus of modern times." The Paris Exposition in 1867 gave him the grand medal. Other marks of appreciation were showered upon him.

In New York city Mr. Field is known as the originator of the elevated railway system. He became interested in rapid transit in 1876, and associated with him in his plan Samuel J. Tilden and several other wealthy men. Owing to unfortunate financial transactions in 1887, Mr. Field lost his important interests in the elevated roads. Shortly after this Mr. Field sold the *Mail and Express*, which had belonged to him.

Mr. Field was a man who was extremely fond of society, and who had a large acquaintance among persons of eminence. In 1881 Mr. Field collected a fund amounting to $362,000 for Mrs. Garfield and her children. In April, 1882, an attempt was made to kill Mr. Field by an infernal machine. Although at one time in his life Mr. Field was supposed to have been worth above $6,000,000, he died comparatively a poor man.

THE LATE CYRUS W. FIELD,
PROJECTOR OF THE FIRST ATLANTIC CABLE.

Mather Electric Company Enlarging its Plant.

The Mather Electric Company, of Manchester, Conn., of which Prof. William A. Anthony, the eminent physicist, is electrician, has just broken ground for an addition to its factory of 200x50 feet. The company already possesses a model factory at Manchester. The new building is to be used exclusively for the construction of power machines and large motors. This branch of the Mather Company's business has grown very rapidly during the past year, and the company has been compelled to run night and day to keep up with orders, for if there is anything an enterprising electrical manufacturer dislikes to see escape it is a good large order for machinery. The new building is, therefore, very much needed and will be pushed rapidly to completion.

Mr. N. T. Pulsifer, treasurer of the company, and Mr. A. D. Claflin, general manager, are both gentlemen who believe in steady progress, without a great deal of splurging, and, with the able, technical assistance of Professor Anthony, are extending the business of their well organized company to all parts of the country. The REVIEW wishes them long continuance of their well merited success.

Anaconda Copper to be Refined Electrolytically.

News comes from Baltimore that President J. B. Haggin, of the Anaconda Mining Company, has decided to have the entire output of his mine refined in America, instead of in Europe, and it has been arranged to have the product of the mine undergo the electrolytic treatment at Baltimore. Contracts have been awarded for the enlargement of the works there and the doubling of the Baltimore Electric Company's plant. When these improvements are completed, probably by the middle of September, the works will be able to treat over 4,000,000 pounds of copper ore monthly.

The Telephone at Warwick.

In entertaining the Royal and other guests at Warwick Castle the telephone has played a conspicuous part, says the London *Daily News*. On one evening it was the opera of "The Gondoliers" that was laid on from the Prince of Wales's Theatre, Birmingham; the next night it was the service from Christ Church in the same town. The Prince of Wales having expressed a wish to hear a performance at Covent Garden, application was made at once to Sir Augustus Harris by the National Telephone Company, and the work of fixing the apparatus was put in hand. Thus the performance of "Romeo and Juliet" was transmitted entire, and it is stated to have given much pleasure to the distinguished audience, among whom, besides the Prince of Wales, were the Duke of York and the Earl and Countess of Warwick. The comic opera of "Pepita" and concerts at Liverpool have also been transmitted. After one of the performances Prince George conversed through the telephone with Mr. Gill, the chief electrician of the Liverpool district, and the Countess of Warwick sent special messages of thanks by the same medium to those who in various parts of the country had thus ministered to the pleasures of her guests.

A Dynamo Indicator, or Instantaneous Curve-Writing Voltmeter.

READ AT THE GENERAL MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, CHICAGO, ILL., JUNE 6–8, 1892, BY GEO. S. MOLER.

In connection with the work in dynamo and motor testing in the physical laboratory of Cornell University, it was found desirable that some method should be devised which would enable the student experimenting to very quickly explore the field of a machine, so that he could study some of the changes which might take place even in a few seconds. The double brush method of Dr. S. P. Thompson, and the single brush method of Mr. W. M. Mordey, are in use and give excellent results, but either of these methods requires a few minutes at the very shortest to obtain the data for a single curve.

To attempt to meet this want the writer devised the instrument which is the subject of this paper. It is intended to be used in tracing those curves which show the changes in potential of the two ends of a single coil of the armature, and also those showing the changes between one brush and one of the commutator bars, as the armature revolves. The instrument consists in the main of a very rapidly vibrating needle of a voltmeter, and a smoked cylinder against which the pointer is made to press at the required moment. The curve is traced during a single revolution of the armature and is then easily transferred to paper, and is thus placed in a permanent form to be studied at leisure. The voltmeter, which is inclosed in the body of the instrument, is of the permanent magnet form. The needle is of soft iron, and is very short, and held at zero by being placed between the poles of a powerful steel magnet. The point is made of aluminium and is quite short. It is shaped so as to be as light as possible, and so that the air cannot offer much resistance to its motion. The cylinder is of metal and very smoothly finished, so that it will offer little resistance to the movement of the pointer.

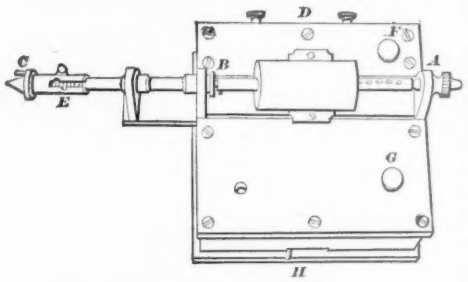


Fig. 1.

It is mounted upon a short shaft and is arranged so that it can be slid to several different positions; a spring dropping into notches holds it at each place. The stationary pivot at *A*, Fig. 1, is made with a spring so that the cylinder can be quickly removed for smoking or for transferring the curves. This short shaft is connected with the driving shaft of the instrument by projecting pins at *B*, so that it will always maintain the same relative position with the pin at *C*. The pin *C* is attached to a sliding sleeve which is pushed toward the point of the shaft by a spring. A hole or a pin in the end of the armature shaft is to engage with the pin *C*, so that the cylinder will always have the same relative position with the armature. To operate the instrument two insulated wire hoops or bands are to be wound around some convenient part of the shaft or commutator, and one is to be connected to one commutator bar and the other to one of the adjacent ones. Small brushes are to be made to press upon these bands, and they are to be connected to the binding screws at *D*. The cylinder is then lightly smoked by removing it, and revolving it over a candle or gas flame; then it is placed in position. The sleeve carrying the pin *C* is pulled back and latched in the notch *E*. Then the point is pressed into the center hole in the end of the armature shaft; this will put the drum in motion; then by letting the projecting knob strike the finger the sleeve will be unlatched, and will spring forward and engage with the pin in the end of the armature shaft. Then pressing the button *F* closes the circuit, and pressing *G* brings the pointer against the drum. *H* is a reversing switch. The base line of the curve is drawn by pressing *G* only. Another form of curve will be obtained if one of the terminals of the indicator is attached to one of the permanent brushes of the dynamo, and the other to one of the brushes pressing upon the band connecting with one of the commutator strips. Also a temporary exploring coil may be wound upon the armature, and its terminals may be connected to the indicator.

The voltmeter of the indicator is necessarily one of low potential, so far that the changes in a single coil will produce a suitable deflection. For greater changes of potential a resistance must be used in series with it. The curves are transferred from the smoked cylinder by dampening a sheet of paper and then rolling the cylinder over it. Three distinct copies have in this way been made from one set of curves. One of these instruments has been built and has been tested in various ways, and is found to give very satisfactory results. The rate of vibration of the needle was determined while the pointer was in contact with the revolving drum and was obtained as follows: A current was applied so as to produce a deflection, then, while the drum was revolving at over a thousand revolutions per minute, the needle was brought in contact with it and the circuit was then broken, making a wavy line extending part way around the drum before it died out. The average rate of oscillation, as determined from over 40 measurements, was 103 per second, and the damping effect was so great that in .04 of a second the needle was brought to rest. It was also observed that the deflection was not changed by bringing the pointer in contact with the revolving drum.

One of the desirable features of the indicator is the rapidity with which the curves can be made. The cylinder full of curves, 18 in all, with their base lines, were made in 73 seconds, so it is seen we can explore the field many times while a dynamo is charging up just after being started, or while any great change in load is being made.

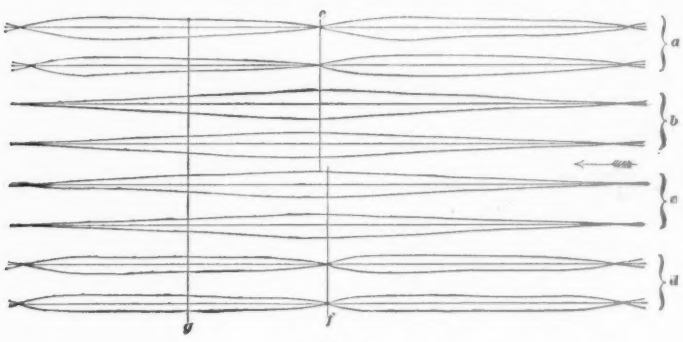


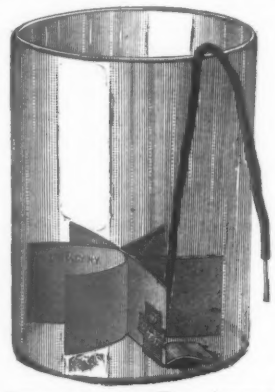
Fig. 2.

Fig. 3

In Fig. 2 are shown some of the curves produced by exploring the field of a 20 ampere shunt wound dynamo of the consequent pole type. The dynamo was driven at a speed of 1,075 revolutions per minute, and had an automatic regulator which held it at 115 volts with slight variations. The curves *a* and *b* were made while 20 amperes were flowing in the main line, and *c* and *d* while the outside circuit was broken. The curves *a* and *d* show the changes in potential of the two ends of a single coil. The line *g* shows the position of the center of the pole piece, and the arrow the forward direction of the curves. The double curves upon each base line were made by reversing the terminals by means of the switch *H*. The line *e* is the position of the neutral point when 20 amperes were flowing, and *f* its position when the line is open. The difference in shape of the curves shown at *a* and those at *d* is very marked. The curves *b* and *c* were made by connecting one terminal to one of the dynamo brushes, and the other to one of the brushes connected to one end of a coil. These also show the change of the neutral point, and a change in shape for open and closed circuit.

The instrument is calibrated by comparison with a standard voltmeter. For each reading on the voltmeter a line is drawn around the drum. When the pointer is not in contact with the drum some of the effects of inertia can be noticed; but when contact is made they seem to almost disappear, and corrections may be applied to compensate for the lag on that account.

To test the reliability of the instrument, one of the 20 ampere curves for half a revolution and similar to *a*, Fig. 2, was taken at random, and the data taken by two students, over which to obtain they worked at least an hour, and had to contend with fluctuating speed and voltage. These two curves were drawn to the same scale and are shown in Fig. 3, the heavier and most fluctuating line being by the experiment. The agreement is about all that can be expected, so it seems that the instrument is capable of giving reliable results.



GREELEY'S CROW FOOT ANCHOR.

The McCreary Rheostat Switch.

The McCreary Electrical Specialty Company, of 136 Liberty street, New York, has recently produced a rheostat switch for regulating incandescent lamps. By its use the electric light can be turned up or down the same as gas. The device illustrated herewith is single pole, simply constructed, easily connected, has perfect regulation and is about the size of an ordinary 10 ampere switch. It can be put up in any convenient place the same as a switch. The makers claim that by the use of this rheostat switch the life of the lamps is prolonged, because the whole current is not turned into the lamp at once. By gradually throwing in the current the filament of the lamp becomes slowly heated until it is at full candle-power, thus saving it from the sudden strain of the full current. This switch will work equally well on fan motors, giving a total number of speeds corresponding to the number of contacts in the rheostat. The resistance employed does not make use of small and easily burned up wires. The switches at present are made for one 16 candle-power lamp for any voltage up to 115. Other sizes for 2, 3, 4, 6 and 10 lights will soon be on the market.

MCCREARY'S RHEOSTAT SWITCH.

A Good Vacuum Pump.

Mr. Norman Hubbard, of No. 93 Pearl street, Brooklyn, New York, manufacturer of the Packard vacuum pump, which is so well known in connection with the manufacture of incandescent lamps, has recently supplied one No. 3 pump to the Edison Lamp Company, Harrison, N. J., and one No. 3 and one No. 4 to the Dominion Electric Company, Montreal. Mr. Hubbard informs us that there are now upward of 150 of these pumps in use in this country and abroad, and that recent improvements of very great value have been made.

LITERARY.

We have received "Reports from the Consuls of the United States" for May, 1892.

Printed matter recently received from Tulane University, of Louisiana, indicates that a satisfactory course in electrical engineering is there provided for progressive Southern students.

In order to stimulate American composition, *The Ladies' Home Journal* has just made public an attractive series of liberal prizes for the best original musical composition by composers resident in the United States and Canada. The prizes call for a waltz, a piano composition, a pleasing ballad and a popular song, an anthem and the four best hymn tunes. The competition is open until November 1, next. The opportunity has an additional attractiveness since the prize compositions will form part of a series for which Strauss is writing an original waltz, and Charles Gounod and Sir Arthur Sullivan each an original song.

The Gravity Copper Anchor.

This illustration shows a valuable improvement which has been lately made in the gravity battery copper, consisting of an anchor attachment for securely and permanently fastening or anchoring the copper to the bottom of the glass jar. The liability to displacement of the copper electrode has always been a serious obstacle in the way of getting the best results from the popular gravity battery.

The new device shown above effectually prevents the copper from rising above the bluestone. The copper being held firmly on the bottom of the jar, a uniform distance is had between the two electrodes in all the cells of a battery, and consequently uniformity of resistance throughout, and the highest efficiency promoted.

The anchor is made of a piece of sheet copper with a coat of adhesive compound or cement on one side, the upper end being riveted to the electrode, together with the copper connecting wire. When packed for shipping the anchor is rolled up in the shape of a cartridge with the cement on the inside.

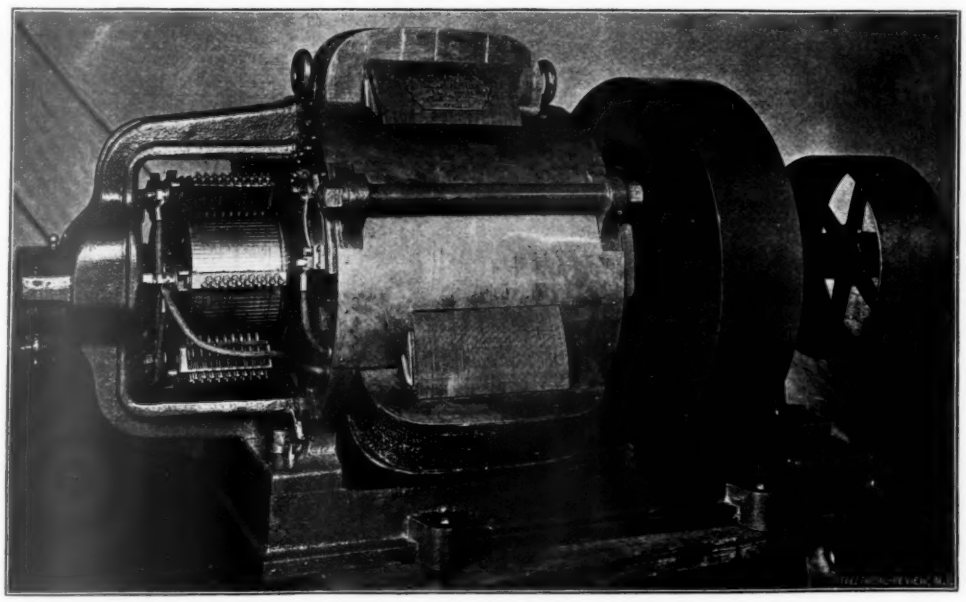
To apply the anchor it is simply necessary to unroll the cartridge, bend it back at right angles parallel with the bottom of the jar, slightly heat the cement over the flame of a match or lamp, and the strip is then ready to be pressed down against the bottom of the jar into position. A little cold water is sufficient to chill and set the cement.

Thus fastened the cohesion of the cement is sufficient to stand a strain on the wire equal to many times the weight of the jar without dislodging the anchor. This new copper is now being placed on the market by The E. S. Greeley & Company, sole agents.

A Perret Dynamo to be Operated by a Gas Engine.

The Elektron Manufacturing Company, of Springfield, Mass., manufacturers of the well known Perret dynamos and motors, have recently produced a dynamo to be operated by a gas engine, an illustration of which is shown herewith. It is one of several similar machines which the company has recently made. The one illustrated has a capacity of 150 sixteen candle-power lights. The shaft is made longer than usual at the end of the commutator to carry the heavy fly-wheel, outside of which an additional bearing is provided. This fly-wheel is necessary to get good results when a gas engine is used as the motive power, for the reason that the pressure of the cylinder in the engine is not uniform throughout the stroke. Some engines explode the gas once to each revolution, and some only once in two revolutions, which is apt to produce unsteady power and consequently a flicker in the light. Unsteadiness is prevented by use of the heavy fly-wheel, which carries the shaft in the armature at a steady speed. The dynamo is one of the Perret low speed multipolar type.

The Elektron Manufacturing Company is experiencing an increasing demand for these low speed dynamos as the public becomes acquainted with their advantages, and a similar increasing demand for the Perret motors. During the month past, in spite of the company's large facilities, the shops have had to run over time, and the month of June witnessed the largest business the company has ever had. Among recent sales of the company is one of 47 horse-power in Perret motors to operate the whole plant of the Citizen Newspaper Company, of Brooklyn, N. Y. The supply of current for operating the motors will be furnished by the Edison Illuminating Company, of Brooklyn.



A Perret Dynamo to be Operated by a Gas Engine.

The Queen Resistance Testing Sets.

Queen & Company, Philadelphia, are having a great "run" on their standard portable testing sets, as the distinctive merits of these goods make them very popular. In every central station, no matter how small, it is real economy to have accurate apparatus for measuring resistance of lines, dynamos, lamps, etc., and the Queen set "1891" type, with its wide range, accurate adjustment and dead beat galvanometer, proves wonderfully efficient. Although introduced less than one year ago, it is to be found all over the country, and indications point to a steady and increasing demand.

A few years back a commercial resistance set correct within one or two per cent. was considered very "close," but such finds little sale now in comparison with the improved forms made by Queen & Company, who guarantee them absolutely to one-fifth of one per cent. Electrical engineers, as well as central station superintendents, will do well to examine the telling features of these sets before ordering such apparatus. They are fully described in circular No. 285, which can be had by writing to the makers.

Our Street Railways.

Twenty-five lines of street railway are in operation in New York city, including the elevated, says the New York *Sun*. Besides having the distinction of being the first horse car line in New York city, the New York and Harlem, now commonly known as the Fourth and Madison avenue line, has the honor of being the first street railway in the world. The line was incorporated on April 25, 1831, and the first cars were run in November, 1832, from Prince street to Harlem Bridge. The cars were almost like the stage coaches that were in use then, each having three compartments with side doors. They had leather springs, and the driver sat on an elevated seat in front and moved the brake with his feet. The first cars were built by John Stephenson.

The opening of the road excited a great deal of interest, and the streets along the route were crowded with spectators. The Mayor and the members of the City Council and other invited guests occupied the cars. It was thought by many that there would be great difficulty in stopping the cars and avoiding accidents to other vehicles. One of the officers of the road determined to demonstrate that the cars could be brought to a dead stop with ease, and, after having instructed the driver, he stationed himself with some witnesses at the corner of Bond street and the Bowery to await the arrival of the first car. At his signal the driver was to stop with all possible haste. The driver of the first car, having had some experience, brought his car to a stop easily, but the driver of the second car forgot the lever of the brake and simply drew hard on the horse lines and shouted "Whoa." The car slid along and the tongue crashed into the rear of the forward car and caused the occupants thereof to jump out. No one was hurt and the cars moved on their way to Harlem Bridge. This is the first street car collision on record.

For some reason the street railway was not very popular with the residents of the city, and, for a time, it was not much used by them. Doubtless, much of its unpopularity was due to the objectionable nature of the rail employed, it projecting too much above the surface of the street, and was injurious to vehicles. The first rails were made with grooves, or iron gutters, to guide the wheels. The low-step rail, now in use, was invented and first used in Philadelphia in 1855.

In 1851 street railways in New York were revived by M. Loubat, a French engineer, who recommended wrought iron rails and wooden sleepers, and constructed, in 1852, the second street railway in the city—the Sixth avenue line—the charter for which was granted on September 6, 1851. The Second avenue line received its charter on January 21, 1853, and the Third avenue line on October 8 of the same year. M. Loubat returned to France in the summer of 1853, and the following year he introduced in Paris the new system of American street railways, known abroad generally as tramways, by laying a line of rail from the Place de la Concorde to Passy on the Avenue de la Reine. That was the first horse tramway in France. George Francis Train introduced the horse car line in England, at Birkenhead, in 1853.

There are 958 street car plants in the United States and Canada now, of which 589 are operated by animals, 50 by cable, 246 by electricity, and 73 by steam. The railway companies in New York seem to prefer the cable to any other improved method of traction. The changes in the Third avenue and the Broadway lines are in that direction. The most serious objections to the cable system are its first cost, the cost of operating and depreciation, and cost of repairs, etc. The cable in use generally measures 1¼ inches in diameter. It is manufactured in lengths of 20,000 feet and weighs about 13,000 pounds to the mile. Its life varies from 6 to 15 months, while some have lasted only a few weeks. Each cable, of ordinary length costs from $6,000 to $10,000. San Francisco leads the world in the number of its miles of cable roads. In California the cables last longer than anywhere else in this country, owing to the absence of frosts and the comparatively light loads drawn.

The 25 city car routes in New York have been operated by 17 companies, of which the Third Avenue line is practically the largest, its total length of track, sidings, etc., being 28.37 miles. Last year it owned 421 cars and 1,740 horses. The Second Avenue line last year had 1,900 horses in use. The total length of all the city car lines, excluding the elevated, is 268 miles. Last year 2,378 cars were in use, and 15,280 horses were required to operate the roads. There are 963 miles of tramways opened for passengers in Great Britain. The working stock consists of 4,067 cars, and animal traction is still the favorite method. In 1891 9,000 horses were employed and 579 steam locomotives; 565,000,000 passengers were carried, and the receipts were $16,451,000. The value of the tramways is about $70,000,000. The value of the roads in the State is $73,000,000.

The total length of the elevated lines in this city is 32.40 miles. They operate 921 passenger cars, 27 service cars, and 291 locomotives, and they carried in 1891, 185,833,632 passengers, or an average of 509,132 a day. The shortest street railway in the city is the line through the Central Park transverse, from Eighty-fifth street and Fifth avenue, to Eighty-sixth street and Eighth avenue.

The Metropolitan Traction Company was organized in 1891, with a capital of $20,000,000, to operate the roads controlled by the Broadway and other companies. It now owns the stock of the Houston, West Street and Pavonia Ferry Railroad Company, a controlling interest in the Twenty-third Street Railroad Company, and all the stock of the Broadway Surface Railroad Company.

The movement of passengers over the street cars and elevated roads increased in five years from 272,000,000 in 1884 to 397,000,000 in 1889, an increase of 46 per cent. If the increase for the next five years be proportionate, the movement of passengers over the lines will be nearly 580,000,000.

Ten Years of the Telephone.

The census bulletin relating to operating telephone companies has a peculiar interest as exhibiting the growth of a great industry in the course of its first statistical decade, says the Boston *Herald*. Boston, as the financial center of the telephone interest and the headquarters of the great American Bell Telephone Company, has a special concern in these figures. The telephone, perfected as a practical instrument early in 1877, did not become of marked commercial importance until the census year 1879–80, when the tenth census noted its unprecedented development, the business amounting to little or nothing at the beginning of the year, and at the end representing one of the greatest interests of the country.

The first item in the report illustrates in a striking manner the tendency of the day toward a consolidation of interests under great aggregations of capital, with a corresponding economy of energy and money. In 1880 there were 148 companies, firms or individuals engaged in the business, and in 1890 the number had been reduced to 53, a decrease of 64.19 per cent. It will be remembered that here in New England there was a considerable number of companies, all of which are now merged into one gigantic corporation. Competition did not last long in the telephone business, and the merging of the Edison with the Bell interests brought it to an end. It is claimed that in such a business competition is impracticable, in the nature of things, for the value of a telephone service consists chiefly in the extent of its connections, and if subscribers were separated into disconnected groups by rival companies the value would be correspondingly diminished. The telephone is consequently a gigantic monopoly in this country to-day, all the various companies being subsidiary to the parent concern, the American Bell.

From a total investment of $14,605,787 in 1880, there was an increase to $72,341,736 in 1890, an increase of 395.30 per cent. The gross earnings increased from $3,098,081 to $16,404,583; the gross expenses from $2,373,703 to $11,143,871; the net earnings from $724,378 to $5,260,712; the number of exchanges from 437 to 1241; the number of telephones and transmitters from 108,638 to 467,356; miles of wire from 84,305 to 240,412; the number of employés from 3,338 to 8,645, and the number of subscribers from 48,414 to 227,357. The number of conversations recorded in 1890 was 453,200,000. There was a decrease in the interest-bearing and profit-sharing investment per mile of wire, amounting to 29.34 per cent., but an increase per subscriber of 5.3 per cent. The net earnings per mile of wire increased 3.6 per cent., and per subscriber 54.68 per cent. The increase in the number of subscribers was 369.61 per cent., and in the number of employés 158.99 per cent.

Every figure indicates a vast and remarkably prosperous business. Great changes have taken place in the methods during the decade. Appliances have been brought to a high degree of completion. The annoyance from induction has been greatly diminished by ingenious devices, and where metallic circuits have taken the place of ground connections it has been entirely overcome. In the great cities underground communication has been introduced to such an extent that in 1890 there were 54,690 miles of buried wire. Long distance telephony has been so perfected that conversations are as easily carried on between many of the great cities of this country and between the leading capitals of Europe as between persons in the same city.

In other countries the development of the telephone has been comparable to that in this country. Germany, for instance, where the telephone forms a part of the postal system, boasts of the best and most extensively used service in the world, with the lowest rates. The telephone affords the most remarkable instance in the history of modern invention of the immediate utilization of a great discovery, developing within a comparatively few months into a vast industry of such service that to dispense with it to-day would produce social and commercial inconvenience to an extent hardly conceivable.

The future of the telephone still has great and undeveloped potentialities. It seems probable that all parts of the world may be brought into speaking communication with each other in the course of a few years, for even trans-oceanic telephony is regarded as feasible by the foremost electrical authorities, though the obstacles at present are great. The telephone also promises to become of much service in the way of enjoyment, as well as utility, for the anticipations of hearing concerts, lectures, etc., at a distance has already been realized to a considerable extent. In this country the rapid extension of long distance telephony promises to build up a formidable competitor to the telegraphic monopoly that rules us, for it seems likely that the finely equipped telephone lines will ultimately be utilized for telegraphy also.

ELECTRICAL REVIEW

Published at 13 Park Row,
P. O. Box 3329. NEW YORK.

EDITOR:
CHARLES W. PRICE.
ASSOCIATE EDITORS:
STEPHEN L. COLES.
ROBERT H. READ.

REGISTERED CABLE ADDRESS:
ELECTVIEW," NEW YORK.
"1546 CORTLANDT," TELEPHONE CALL.

BOSTON OFFICE:
W. I. BARKER, Room 29, 620 Atlantic Ave.

WASHINGTON OFFICE:
GEO. C. MAYNARD, 1409 New York Ave.

CHICAGO OFFICE:
MERWIN J. BULKLEY, 435 "The Rookery."

EUROPEAN OFFICE:
JOSEPH FFRENCH, Editor for Europe.
HOTEL VICTORIA,
Northumberland Ave., Charing Cross, London, W. C.

Cable Address: - - "Electview," London.
Telegraphic Address: Ffrench, "Victoriola," London.

ADVERTISING DEPARTMENT,
H. T. RICHARDS, Manager.

PATENT BUREAU,
ROBT. H. READ, Manager.
Patents procured in United States and all foreign countries. Searches, Investigations and Reports on Validity and Infringement.

SUBSCRIPTION TO THE ELECTRICAL REVIEW.
One Year, United States and Canada, - $3.00
One Year, Foreign Countries, - - 5.00
Single Copy. - - - - - - - .10

NEW YORK, JULY 23, 1892.

CONTENTS.

	PAGE.
Views, News and Interviews	279
A Cyclone's Visit to a Telephone Exchange	279
The Canadian Niagara Power Company	279
Telephone Cables in the North River	279
Can't Steal Electricity	279
Light and Power Stations	279
The Clam Crop is Ripe and will be Harvested	280
A New Electric Tower Clock	280
Philadelphia Telephone Rates Reduced	280
Getting the Worth of One's Money in Advertising	280
The Worcester and Millbury Street Railway Company	281
Homestead Strikers Rent the Whistle	281
Electric Launches for the World's Fair	281
Mather Electric Company Enlarging its Plant	281
Death of Cyrus West Field	281
Anaconda Copper to be Refined Electrolytically	281
The Telephone at Warwick	281
A Dynamo Indicator; or Instantaneous Curve-Writing Voltmeter	282
The McCready Rheostat Switch	282
A Good Vacuum Pump	282
Literary	282
The Gravity Copper Anchor	282
A Ferret Dynamo to be Operated by a Gas Engine	283
The Queen Resistance Testing Sets	283
Our Street Railways	283
Ten Years of the Telephone	283
Dynamos for Fire Alarm System	284
The Press Club Dinner	284
Cyrus West Field	284
Correspondence:	
Our Seattle Letter	285
Our Chicago Letter	285
Our Boston Letter	285
Electric Wiring and Insurance	285
Personal	285
Letters from a Laboratory—IV	285
Electricity in Bituminous Mining	286
The Future of Electric Railways	289
Thomson-Houston Dividend	289
Murat Halstead on Cyrus W. Field	290
Third Annual Meeting of the Massachusetts Electric Light Association	290
The Kester Arc Lamp	290
New Iron Buildings	290
Advance Information	291
A New York Electric Railway	291
The Edison Electric Illuminating Company, of New York	291
Kindred Interests	292
Electrical Patents	xii

INDEX OF ADVERTISERS.

COVER PAGES.	PAGE.
American Electrical Works	i
Ansonia Brass & Copper Co	xviii
Armington & Sims	xviii
Babcock & Wilcox Co	xviii
Baker & Co	xviii
Beacon Vacuum Pump and Electric Co	i
Benedict & Burnham Mfg. Co	ii
Crocker-Wheeler Motor Co	i
Day's Kerite	xvii
Dixon Crucible Co	xviii
Eastern Electric Cable Co	xviii
Eddy Electric Mfg. Co	i
Hampson & Co., E. P	xviii
Jewell Belting Co	xviii
Moore, Alfred F	xviii
Noye Mfg. Co., John T	xviii
Okonite Co	i & xviii
Otis Bros. & Co	xviii
Perkins Electric Lamp Co	i
Simplex Electrical Co	i
Star Electrix Co	i
Van Nuis, C. S	i
Wainwright Mfg. Co	i
Washington Carbon Co	ii
Waterhouse Bros	i
Weston Engine Co	i
Wheeler Condenser & Eng. Co	xviii
Wilmot & Hobbs Mfg. Co	xviii
INSIDE PAGES.	
Allis & Co., Edward P	xi
American Bell Telephone Co	xv
American Engine Co	xii
Ball Electric Light Co	xiv
Ball Engine Co	xii
Barnes Co., W. F. & John	xii
Barrett, John A	xii
Bernstein Electric Co	x
Bickford & Francis Belting Co	xi
Bishop Gutta Percha Co	xi
Brill Co., J. G	xv
Brush Electric Co	xvi
Buckeye Engine Co	xi
Burton Electric Co	xv
"C. & C." Electric Motor Co	ix
Central Electric Co	iv
Central Complete Combustion Mfg. Co	xvi
Chester Steel Castings Co	xv
Church & Sleight	xv
Conover Mfg. Co	vi
Cowles Electric Smelting and Aluminum Co	292
Cutter, George	x
Detroit Electrical Works	x
Dwight Slate Machine Co	292
Edison General Electric Co	vi
Electric Construction and Supply Co	xiii
Electric Gas Lighting Co	ix
Electric Secret Service Co	xvi
Elektron Mfg. Co	x
Electro-Light Engraving Co	vii
Empire China Works	xii
Eureka Tempered Copper Co	xiv
Faraday Carbon Co	xi
Falls Rivet & Machine Co	xiii
Fitzgerald, S.	xii
Fletcher & Fletcher Electric Co	vii
Fort Wayne Electric Co	v
Garvin Machine Co	iv
General Electric Co	292
Graves Electrical & Mfg. Co	292
Greeley & Co., The E. S	xiii & xv
Holmes, Booth & Haydens	ix
Independent Bung Co	xiii
Interior Conduit and Insulation Co	xi
Johns Mfg. Co., H. W	v
Kellogg Iron Works	viii
Klipstein, A	xv
Law Battery Co	292
Leclanche Battery Co	xi
Lehigh Valley Creosoting Co	xi
Leonard & Co., H. Ward	vii
MacKie, Robb	292
Marshall, Wm	xii
National Pipe Bending Co	xi
New England Butt Co	xiii
New York Belting and Packing Co	xv
New York Insulated Wire Co	xi
Novelty Electric Co	iii
Onondaga Dynamo Co	vii
Ostrander & Co., W. R	vii
Penn Life Co	xii
Pierce & Miller Engineering Co	xii
Phosphor Bronze Smelting Co	vii
Prentiss Tool & Supply Co	292
Queen & Co	xii
Railway Equipment Co	vii
Rhode Island Tool Co	vii
Ries Electric Specialty Co	vii
Ridlon & Co., Frank	xii
Rosenbaum, Wm. A	xii
Royce & Marean	292
Roy Valve Co	iii
Sawyer-Man Electric Co	vi
Seely, John A	iii
Schuyler Electric Co	v
Shawmut Fuse Wire Co	xiii
Shipman Engine Co	xi
Short Electric Railway Co	x
Simpson Electric Mfg. Co	xiv
Sioux City Electric Light Co	292
Solar Carbon & Mfg. Co	vi
Standard Electric Time Co	vii
Stevens & Morris	xv
Stocking, E. B	xii
Thomson-Houston Electric Co	vi
Time Electric Co	292
Tyndall, Wm. D	xii
Waddell-Entz Electric Co	iv
Walworth Mfg. Co	iii
Washburn & Moen Mfg. Co	xii
Watson & Stillman	xv
Western Electric Co	xiii
Westinghouse Electric & Mfg. Co	iv
Willson, H. B	xii
Woodhouse & Rawson	xv

It is now learned that several months before his death, Cyrus W. Field presented to the Metropolitan Museum of Art his entire collection of medals and paintings relating to the laying of the Atlantic cable. A condition of the gift was that the articles should be kept together in an alcove of the building and so arranged that they could be readily examined by the public. Gen. di Cesnola, director of the Museum, will soon publish a complete list of the articles in the collection. Mr. Field could have made no better disposition of these historic treasures, and no better or more available custodian than our Museum could have been selected.

"Electricity in Bituminous Mining" is the title of Mr. Elmer A. Sperry's very interesting address recently delivered before the American Institute of Electrical Engineers. It is probably the most complete exposition of the application of electricity to soft coal mining that we have yet had. Mr. Sperry considers the subject from the standpoint of the mining engineer with the eye of the electrical engineer. The most perfect form of electric coal cutter would seem to be a machine of the direct blow type possessing the requisite details of economy, efficiency and practicability. Mr. Sperry's figures as to the amount of work already accomplished by electric mining machines indicate the present extended use and the future field of this apparatus.

Peltier observed that waterspouts were generally accompanied by electrical conditions. Might there not be like conditions attending the formation of these terrible tornados that are continually doing so much damage in the West? They are practically the same. On water moisture and spray are the revolving material, while on land it is but whirling air. This rapid whirling mist produces considerable friction as it rushes through the atmosphere; hence, it seems that electricity must be generated.

If this be really so, then Franklin's electric chimes ought to serve as a practical indicator of their approach, thus enabling the inhabitants to seek their prepared places of shelter with plenty of time to spare to save whatever valuables they choose.

Or supposing that they are due to an electrical condition of the atmosphere, then might not several high towers be erected somewhere in the neighborhood of the city to draw from the clouds whatever charge there may be in them, thus abstracting the initial charge which may, as in the Holtz machine, be absolutely necessary to the formation of one greater and more intense?

The news that the Second Avenue street railway in New York city is to adopt the storage battery for motive power is most encouraging. It means that the electric railway has at last secured a foothold in the metropolis.

The Christian Endeavor delegates who recently invaded New York city have furnished much amusement for the natives. A crowd of Endeavorers one day inspected the Brooklyn Bridge. A California girl asked if Edison had not built the bridge. One of the delegates said he didn't think so, but he might have made the cable that propelled the cars.

Electricity and its attendant devices have been used for multifarious purposes. It has some connection with nearly every great happening in these modern days. In the deplorable labor troubles at Homestead, Pa., the whistle of the electric light plant was used by the leaders to convey signals to the strikers. It is said that the strikers "rented" the whistle. How, and from whom and by whose authority?

DYNAMOS FOR FIRE ALARM SYSTEMS.

The inspector of wires of the city of Boston, Captain Brown S. Flanders, has recommended that the electric circuits for the fire alarm system should be sustained by dynamo currents instead of batteries, which are in universal use. The advantages of this change are numerous and apply to nearly every condition that can be considered in the matter, especially in connection with the large amount of room and the attendance necessary in connection with the batteries, and also the better condition in which the currents from the dynamo can meet the disturbances arising from either the contact with wires conveying other dynamo currents used for illumination or for the transmission of power.

THE PRESS CLUB DINNER.

The members of the New York Press Club, to the number of nearly 300, dined at the Manhattan Beach Hotel Thursday evening of last week, Hon. Chauncey M. Depew presiding. The meeting was for the purpose of discussing the ways and means of erecting a Press Club building on the valuable site recently secured at the corner of Frankfort and William streets, this city.

The dinner was a particularly fine one, Proprietor Silleck, of the hotel, sparing no pains to accommodate his guests. Addresses were delivered by Mr. Depew, who never spoke better in his life, Col. John A. Cockerill, president of the Club, Charles O'Connor Hennessy, John W. Keller, Dr. John Friedriech and Charles J. Smith. Several contributions were announced as coming from leading citizens of the city. A characteristic message was received from Mr. Thomas A. Edison, which read as follows:

"Haven't time to attend your dinner, but will squander one thousand on your Club project."

This was received with much applause. A general executive committee, composed of Chas. O'C. Hennessy, W. J. Arkell, Chas. W. Price, Chas. J. Smith and James F. Graham, President Cockerill, member *ex-officio*, and Hon. Chauncey M. Depew, counsel, was appointed to have general charge of the matter, and a committee of 100 members of the Press Club was announced on ways and means. Mr. Geo. M. Phelps, of the *Electrical Engineer*, and Mr. C. E. Stump, of the *Street Railway Journal*, were appointed on this committee.

The meeting was the largest, most representative and most enthusiastic ever held by the Press Club and augurs well for the success of the building project, which is, in every view of it a particularly worthy one.

CYRUS WEST FIELD.

Cyrus West Field, of submarine cable fame, is dead. We have no standard of measurement by which to observe the influence he exerted upon electrical development, but it is certain that his untiring energy, faith and final success in laying the first Atlantic cable entitles him to be placed with our other great men who have done much for the world's good. Mr. Field entered upon the project to gratify a most commendable ambition, and as a commercial enterprise promising sufficient returns. But of what avail would be inventive genius were it not supported on the commercial side by men of wealth and foresight?

Cyrus Field knew in his life as large a measure of pain and pleasure as probably ever fell to the lot of man. He experienced the hard lessons of poverty, the luxury afforded by millions, the tender love of an affectionate and high-minded wife, and the sorrows of old age, occasioned by an unfortunate son. The plaudits of the world were his, honors had been heaped upon him by societies, he had the friendship of many eminent people.

To Cyrus W. Field New York city owes such rapid transit facilities as the elevated railways now afford, and had it not been Mr. Field's misfortune to be "squeezed" in an elevated railway deal with other capitalists in 1887 these roads would now, undoubtedly, be operated by electric power. It was just at this time that Mr. Stephen D. Field, the eminent electrical inventor and nephew of Cyrus W. Field, demonstrated by successful experiments the feasibility of applying electric power to the propulsion of elevated railway trains. Cyrus Field's interests falling into more conservative hands prevented the fulfillment of his own and his nephew's plans.

Cyrus West Field's name will live with us always. It has been celebrated in prose and poetry and in the text books of American school children. But, better than all, his name lives in the minds and hearts of those who appreciate the man for his own worth and who can realize to some extent the benefits accruing from his undertakings.

The systems of weights and measures in use by the Americans and the British have long since been condemned by men of science. Their use has undoubtedly retarded the progress of scientific relationship between countries of different nationalities. The metric system seems to fulfill all practical requirements, the only difficulty being that of successfully introducing it. In England, the New Decimal Association has memorialized the House of Lords on the necessity of taking important steps for the introduction of the metric system in that country. The American Metrological Society has prepared a petition asking Congress to pass the following act:

"That on and after July 1, 1893, the metric system of weights and measures authorized by the Act of Congress approved July 28, 1866, shall be used exclusively in the customs service in the United States."

The passage of this act would be a step forward toward the general adoption of the system. Those interested strongly in the subject may like to know that the office of the American Metrological Association is at 41 East 49th street, New York City. Dr. B. A. Gould is president of the society and Mr. John K. Rees is secretary.

On another page will be found the first of a series of papers on "Light and Power Stations," by a practical engineer, Mr. Robb Mac Kie. Some telling truths are set forth as to the present condition of many of our electrical plants. There has been some excuse for flimsy work in the past, but in these days no argument can be advanced in justification of cheap and dangerous construction. The advantages accruing from high class work are obvious, and the wonder is that they are not more extensively realized. Mr. Mac Kie's plea for the employment of a first class supervising engineer, when electrical plants are built, is a timely warning, and should not fail to be observed. The best work is always the cheapest.

CORRESPONDENCE.

OUR SEATTLE LETTER.

Kent has voted to issue bonds for $23,000 to put in a water and electric light plant.

The Latona and Brooklyn End of the Rainier Power and Railway Company's line will be completed in 60 days.

The Power House of the Grant Street Electric road is completed, but the boilers have been delayed in coming from the East.

A Company has incorporated at Sumner to furnish electric light. The capital stock is $50,000. The incorporators are G. H. Ryan, A. B. Wood, P. D. Rice, W. R. Lindsay and George Herriott.

Allen C. Mason is trying to foreclose a mortgage on the Tacoma and Puyallup steam motor line. If he succeeds the line will pass into the control of the Tacoma, Point Defiance and Edison Line, and be equipped with electricity.

L. H. Griffith, manager of the Seattle Consolidated Street Railway Company, has been elected director and general manager of the Tacoma City Railway Company. While managing the Tacoma system, he will retain the management of the consolidated lines in Seattle, for they are so well organized that they do not need his whole attention.

In Spokane a few days ago two masked men boarded an electric car a little before midnight. One of them presented a loaded pistol at the head of the motorman, and thus stopped the car, while the other robber attempted to steal a pocket book from the only passenger. The latter escaped with his money and a pistol shot through the hand.

Plans are being laid for an electric road from Spokane to Fort Sherman in Idaho, 30 miles distant. The falls at Spokane and at Post Falls supply plenty of power for generating the electricity. The run can be made in an hour, and the beautiful Coeur d'Alene lake brought near enough to Spokane to be one of that city's most attractive pleasure resorts.

The Electrical Equipment of the Point Defiance and Edison line is nearly complete. The Thomson-Houston Company is doing the track work and the Edison Company is furnishing the cars with single reduction motors. Seven cars are being equipped with 14 single reduction motors, and five new cars, now on the way to Tacoma, are expected daily.

The City Council is trying to force the Consolidated Street Railway Company to light certain streets through which it operates lines. According to the terms of the franchise the company was to light these streets; but the company now pleads that it cannot light these streets without adding to its plant, and the revenue from travel does not warrant such an outlay.

The Seattle City Council has been investigating the question of the advisability of having the city put in its own electric light plant. The council has found that the city is paying about $3,100 per month under the present contract system, but a plant would cost $90,000 and the operating expenses would be about $2,000 a month. Accordingly the decision has been made to adhere to the present system.

The Consolidated Street Railway Company intends to sink an artesian well at its power house, and it may be joined by the Union Electric Company in the enterprise. It is expected that at a depth of 200 feet enough water can be found to supply both power houses, and save each company over $100 a month. The Consolidated Street Railway carried 12,000 passengers on Sunday last, and all the street railways in the city carried about 35,000.

Edmund Cosgrove and Hugh Eldridge, who are large stockholders in the Fairhaven and Whatcom Electric Road, have brought from John H. Stenger, J. W. Morgan and F. C. Pettibone, a controlling interest in the Bellingham Bay Electric Street Car Line, which occupies the principal streets of Whatcom. This purchase means eventual consolidation of the two lines. The Bellingham Bay Company has elected Hugh Eldridge, president; P. B. Cornwell, vice-president; Victor Roeder, treasurer, and E. B. Leaming, secretary.

The Tacoma and Steilacoom line, owned by the Thomson-Houston Company and the Tacoma Railway and Motor Company, have finally been consolidated, and the formal transfer will take place soon. There was some hitch over the bargain last month, and Winthrop Coffin, of Boston, who looked over the ground, reported unfavorably as to the price. This matter was finally settled and the consolidation consummated. The electric power house on the Steilacoom end of the road will be dispensed with and steam motors used on that end of the line.

The Option which the General Electric Company held on the electric railways of the city has expired and has been allowed to lapse. The reason is understood to be an adverse report from Winthrop Coffin of Boston, the agent of the General Electric Company, who examined the lines as to the valuation put on them under the consolidation agreement. The idea of consolidation has not been abandoned, however. It is understood that an effort will be made to carry through the deal with the General Electric Company on a new basis of valuation. Failing this, a local combination may be arranged without the intervention of the new electric combination.

The Consolidation of the Edison and Thomson-Houston Electric Companies' business in this city, consequent on the consolidation of the two parent companies as the General Electric Company, took place on July 1. A separate corporation has been formed for the Pacific Northwest, under the name of Northwest General Electric Company, and will have its office at 807 Front street, where the Edison company's store now is. W. J. Grambs, now manager for the Edison, will be the local manager, and E. B. Kittle, who has been the Thomson-Houston agent here, will look after the electric railway business in this section, his present subordinates being transferred to Mr. Grambs' office. The stock of the local company will be largely increased.

Seattle, Wash., July 10. H. L.

OUR CHICAGO LETTER.

George Cutter returned this week from a business trip to Boston.

D. B. Dean, of the McGuire Manufacturing Company, left Thursday for a week's trip in the East.

Capt. John McKinlock, treasurer of the Western Electrical Supply Company, the Omaha branch of the Central Electric Company, is in the city for a few days.

Payson K. Andrews, of the J. G. Brill Car Company, returned to the city Wednesday after a 10 days' pleasure trip in the East.

Among the many recent contracts closed by the McGuire Manufacturing Company is the South Chicago City Railway Company, Kankakee Electric Railway Company, Toledo Consolidated Street Railway Company, and Pueblo City Railway Company, Pueblo, Colo.

The Illinois Electric Lamp Company report the sales of a large number of their well known Jewell lamps during the past month, and from the fact that their business is steadily increasing it is evident that the lamps are giving good satisfaction.

J. A. Hanna, who has for the past eight years been connected with the J. G. Brill Car Company, Philadelphia, has resigned his position and accepted a position as general traveling salesman with the McGuire Manufacturing Company, of this city. The many friends of Mr. Hanna wish him success.

The Kester Arc Lamp and Manufacturing Company report the sales for their lamps during the past month as much greater than they had reason to expect. Although on the market but a short time the lamp is meeting with much success and gives general satisfaction.

General Manager Mason, of the Railway Equipment Company, Chicago, has just returned from a Southern trip. The large number of contracts taken by this company this season, as well as the steady increase of supply business has kept the entire force busy for the last six months. With characteristic enterprise the company is bringing out this season several new devices which have the approval of the entire trade. The new offices of the company are very convenient and the company is better fitted than ever to meet the wants of electric roads.

Chicago, July 16, 1892. M. J. B.

OUR BOSTON LETTER.

A New Automatic Electric Alarm has been invented by Mr. Charles L. Woodside, special agent of the North American Insurance Company.

The Van-Choate Electric Car and Light Company, the recently organized manufacturing enterprise, has established offices in the Exchange building, this city.

Mr. Frank A. Wing, electrician, has established himself in business at West Somerville, Mass. He will make a specialty of wiring residences for electric lighting, annunciators, gas lighters or other purposes.

The Chicago Fire-Proof Covering Company, manufacturers of fire-proof insulation for steam pipes, boilers and other heated surfaces, have removed their Boston branch office to No. 159 Pearl street. Mr. Albert Dutton is manager.

The Robinson Motor and Battery Company, manufacturers of a low-priced battery motor, suitable for operating fans, sewing machines, dentists' and jewelers' lathes, etc., etc., have located offices and salerooms in the John Hancock building, this city.

The West End Railway Company, of this city, is rapidly extending its electric system to its various lines; nearly two-thirds of all the cars are now equipped with electric apparatus. On July 13 all the cars on the Somerville line were operated by electricity for the first time.

Mr. A. D. Adams, the genial traveling representative of the Jenney Electric Motor Company, of Indianapolis, Ind., was in Boston last Tuesday, and favored this office with a visit. Mr. Adams is selecting local agents in the East for the sale of the popular and reliable Jenney electric motor.

Messrs. Swan & Lane, No. 194 Summer street, this city, have taken the agency for the Jenney Electric Motor Company, of Indianapolis, Ind. This agency will control the territory of Boston and adjacent districts; yet Messrs. Swan & Lane are privileged to fill orders sent them from any section of New England.

Mr. C. R. Fish, for several years identified with electrical interests in New England and at one time the superintendent of an electric light station near this city, is now employed by Messrs. Swift & Company, of Chicago, Ill., as their manager and electrician, and whose duty it is to look after the firm's isolated plants at Chicago, Kansas City and Omaha.

The Gould & Watson Company, this city, has issued a circular to the electrical trade, announcing the sale of its business and entire Mica stock to the American Mica Company. Mr. George B. Watson, well known to our readers as the treasurer of the first named company, has been selected as the treasurer of the new enterprise. The executive offices of the American Mica Company are at 620 Atlantic avenue, this city.

Messrs. Claflin & Kimball, of this city, have incorporated under the laws of Massachusetts, as the Claflin & Kimball Company, with a capital of $135,000. The officers are: president, Adam D. Claflin; treasurer, Marcus M. Kimball; clerk, George Walker. The new Company will act as general selling agents for the Mather Electric Company and the Perkins Lamp Company, and also do business as electrical engineers and contractors. W. I. B.

Boston, July 16.

Electric Wiring and Insurance.

To the Editor of Electrical Review:

Fire underwriters are greatly disturbed by the increased fire loss, due, as is held by many, to the electrical hazard. I would suggest that you print papers on this subject and give special attention to the following points:

1. Is all, or nearly all, of the old wiring unsafe and likely to cause fires?

2. Can buildings be so wired as to be perfectly safe from the standpoint of the fire underwriter? And if so, how?

3. Assuming that to be safe wires must be inserted in some kind of tubing, what shall it be, considering the question first from the standpoint of absolute safety, and next from the standpoint of economy?

Yours truly,
Henry Evans, Vice Pres't,
Continental Insurance Co.

New York, July 11, 1892.

PERSONAL.

Mr. C. A. Benton, of the Detroit Electrical Works, Detroit, Mich., was in New York last week.

Mr. Wm. Hazelton, 3d, assistant general manager of the Short Electric Railway Company, Cleveland, was noticed in Wall street, last week.

Prof. George D. Shepardson, of the department of electrical engineering, University of Minnesota, visited New York recently and made the Review a call.

Among the new appointments announced at Columbia College is that of Prof. F. B. Crocker, as adjunct professor of electrical engineering. Prof. Crocker is now abroad enjoying a well earned rest.

Mr. Geo. E. Fisher, manager of the Commercial Electric Company, Detroit, Mich., has been appointed chief of the electrical division of the Detroit Exposition for 1892, which promises to be quite an elaborate affair. The building and grounds occupy 72 acres, and the exposition opens August 23, closing September 2. The Commercial Electric Company have the contract for the electric lighting, which will require 300 arc lights and 1,000 incandescents.

Mr. Robb MacKie has been appointed City Electrician of Cincinnati. City officials are not always successful in getting the best talent for this technical side of municipal affairs, as politics so often enters largely into the appointment, but in this case the city is to be congratulated. Mr. MacKie is an able, practical and experienced electrical engineer, and will reflect high honor on the appointment. The Review extends its congratulations to both the city of Cincinnati and Mr. MacKie.

LETTERS FROM A LABORATORY.—IV.

BY JULIAN A. MOSES.

Now is the time when the electrician and chemist turn from the laboratory in the city to that of nature, and in this laboratory try experiments that are only beneficial to the world at large, as far as they give the experimenter new tissue and strength to solve knotty problems in the future.

Experimenting does not stop when the door of the laboratory is locked; nature's country storehouse furnishes abundant material. The laws of nature work here, even on a grander scale than in the laboratory; but they are as sure, and were it possible for us to read her rocks, trees and weather indications as accurately as we do the laws of Ohm or Ampere, the farmer would be born in the purple of the experimenter. But, as it is, he furnishes food and fun for those who write about him.

It is very refreshing to find some one who does not know everything about electricity, and has never seen any other electrical device than a lightning rod.

Coming across one of these individuals the other day, I thought it would be a good idea to get his views on the subject.

He saluted me with the customary, "Howdy, neighbor," and being, like most of his kind, somewhat garrulous, started a conversation which, with my help, finally led up to electricity.

"Neighbor," said he, "see that lightning rod."

I answered in the affirmative, but added, "that it seemed to be broken and, therefore, useless."

"Well, it hain't; it's been on that there house nigh onto 15 years this coming August, and the house hain't been struck but once, and that was in '78; I tell you it's the most useful thing we ever had around the house."

I interrupted him to ask for an account, and give it verbatim.

"Well, since you ask me, I'll tell you," he replied, rather diffidently, "but I don't expect you to believe it; I never told it without the evidence in my hand; no one ever believed it; they said lightning never came through a brick wall, it had to travel on something made of metal; but it must have, this time."

"One day, it was raining cats and dogs, and the lightning was flashing in all directions; mother was sitting in that old rocker, I was sitting right where I be now, and over there, on the stove, was simmering our old teapot, it warn't very new then, and almost ready to throw away, but next day you couldn't have bought it for a farm. Well, sir, it had been getting pretty dark and mother had stopped and was talking to me, when all of a sudden I felt something hit me aside of the head and I saw a big blue ball of fire dancing on the stove. If I hadn't been so scared, I'd have laughed. That big thing just kept dancing until it struck the teapot, when it seemed that they had struck up a great friendship, for they went off together to pay a visit to the old brass kettle that stood on the floor by the water sink. It kept dancing and rolling all around that old kettle, and finally went down the water pipe, and we heard it explode in the cesspool.

"Well, sir, when we had got our senses again, mother looked at me, I looked at her, and we both looked at the old kettle, and I'll be blessed if that teapot hadn't got stuck fast to it."

And he showed me an old black pot that had a badly shattered teapot fastened firmly to its side.

"Well," said I, "why don't you fix your lightning rod; I should think that one experience like that would be enough for a lifetime."

"Why," he answered, very much surprised, "hain't you never heard that lightning never strikes twice in the same place."

There is no doubt that he felt perfectly secure; such is the belief of the ignorant in the simple and homely proverbs of the past and present.

We all remember the sailor who, during an engagement, put his head into the first hole made by the enemy's cannon in the hold of the ship and kept it there, and how he lived to tell "the secret of long life in the service."

If any one will take the trouble to look he will find that there are many houses in our own city that are exactly in the same condition. Of course, lightning has never struck your house, but, as a matter of precaution, look to see if your rod is situated as it should be.

Above all, don't put too much faith in proverbs. Some of them are good, no doubt, but because some one once said that "Nature abhors a vacuum," don't believe that there is no use in attempting to obtain one.

Don't take them too literally, they are only metaphors, and metaphors are almost always imperfect; they are but figures of speech—figures that *do* lie.

Electricity in Bituminous Mining.

READ BEFORE THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, CHICAGO, JUNE 6, 1892, BY ELMER A. SPERRY.

Many a traveling Englishman on this side turns his eyeglass upon a swift succession of passing trains laden with barely a day's product from some unheard of Western colliery, and thinks that he instinctively recognizes pit coals from Northumberland or Lancashire. He supposes "all coals come from Newcastle;" nor is this surprising. The average Eastern man may be said to be almost unaware of the existence of bituminous fuel.

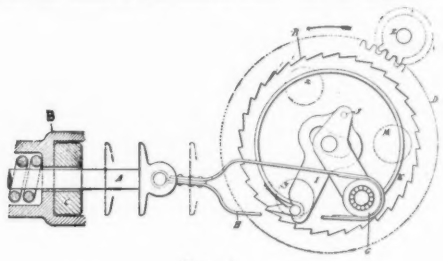


FIG. 1.

FIG. 2.

To him anthracite is coal, and Pennsylvania is the place of its nativity. Yet, last year, 150,000,000 tons of bituminous coal were mined in the United States, principally in the West.

Of the total anthracite product, 78.29 per cent. was shipped to Pennsylvania, New York, New Jersey and New England. To one whose attention has not been directed to the coal industry it is a matter of surprise that extensive mining operations in coal are going forward in the Mississippi valley. On one of the affluents of the Mississippi River alone, in 1888, was shipped nearly as much coal as was in that year mined in all the continental countries of Europe together. In this valley there are 152,000 square miles of coal area. Illinois alone has 36,000 square miles. In this State $18,000,000 are invested, $11,000,000 are annually disbursed, and about 40,000 miners employed in bituminous mines. These areas of the West are large when compared with those of the Eastern States. The coal area of Great Britain is the same as that of the State of Pennsylvania, 9,000 square miles. The coal area in the Mississippi valley is 30,000 square miles in excess of the total superficial area of England, Ireland, Scotland and Wales.

England, doubtless, has the honor of being the first to give up this, the most important of the mineral products. Abundant evidence exists that some of the English outcroppings were worked by the Latins during the Roman occupation. Heaps of debris and cinders from the ancient iron furnaces have been found which were worked at that period so great in extent that modern furnaces are being supplied from them. While it is not clear that coal was used, yet the fact that the Latins introduced the powerful artificial blast renders its use probable, and may explain the large coal workings of the period.

As to implements and machinery, it is true of the various regions and countries of the Old World that if you would know the tools used at an early period you have but to study the tools of to-day. The excavations in the most ancient ruins of civilization show implements used by ancient and contemporary artisans to be the same. Moulds sunk in slabs of limestone used by the most ancient Egyptian silversmiths are identical with those used to-day, and sunk in the same limestone. The iron and bronze implements shown in the ancient traceries have been exhumed, together with the drawings, and compare favorably with the picks and shovels used in their discovery. In Ninevah nearly two tons of iron implements were found, among which were bars, shovels, saws, picks, etc. The picks evince excellent workmanship; they are single and double ended, the double, in some instances, provided with an edge at one end and a point at the other, the eye well formed, with extended lips upon the inside for more firmly securing the wooden handle.

There is no doubt but that the implements and tools seen to-day in use in the Lancashire mines, 3,000 feet below the surface, are the same as used by the Latins and Saxons in the ancient coal workings. The motive power has remained unchanged during the centuries; the instrument is good; the method of attack is simply perfect, and cannot be improved; the system, however, has radical defects in point of expense, controllability, protracted effort, want of uniformity, deficient and small power units. The tendency of the times is toward centralization, and a large unit will be the integer of the future. While others among the older industries have adopted improved methods, the mining of coal has remained almost stationary. Ore mining has been revolutionized in many respects; extensive plants of machinery being adopted have been found to increase the capacity and cheapen the product. In isolated cases coal mines have been equipped with labor saving machinery and the enterprising operator has been richly rewarded. Veins that were operated at a loss have, by the use of machinery, been enabled to yield profitable results. In this line doubtless the next decade will witness great advancement. The problem of replacing manual labor in coal mining has engrossed the labors and thought of the ablest engineers of the age. Some of the earliest patents granted by the English monarchs were for mechanical mining devices with an avowed object of superseding manual labor. These machines were driven by animal or hydraulic power, and more recently by steam and compressed air. They sawed, scraped, cut and plowed, but principally struck a blow. Many, even to a recent date, swung a pick provided with the ordinary transverse handle or power connection. Few, if any, of these machines have been successful under the severe duties required, and none have withstood the test of time. Machines generally employing cutting or scraping devices are of limited application. They are worked with success where the vein is clear; but this, however, is the exception. The presence of iron pyrites or other foreign substances in the strata quickly dulls the knives and requires such heavy driving powers as to preclude commercial use. I have witnessed the operation of this type of machine in strata excellently adapted for machine mining except for a frequent deposit of sulphur about the thickness of a silver dime. The cutters being made of the finest Mushet steel, the entire set required changing every 40 square feet undercut. The current readings would show a power consumption on an average of 27 horse-power, whereas, in clear coal, 10.5 horse-power only were required, and one change of cutters for each 250 square feet undercut.

With a more or less friable material, and especially where a cubical or angular crystal exists, great dislodgement and penetration is accomplished by the percussive blow. Its amount is proportional to the stored energy in the projectile. If the energizing motor is deficient, the strokes or impulses must, of necessity, be feeble; but now that almost unlimited power is at our disposal, the force and work possible is only limited by the rigidity and durability of the immediately attacking medium, namely, the tool or cutter. With this form of machine, and especially if organized to be manually directable, the penetration may be pushed at a rapid pace, the foreign substances may be cut about, dislodged and removed without the necessity of directly attacking the substance itself.

These foreign substances are the bane of mechanical coal cutting. They exist in the form of thin layers, thick layers, balls and boulders. The various forms are known to the miner as sulphur balls, lime balls, boulders, bone coal, etc. They are of extreme density, and their hardness is so great that even with the diamond drill they are considered the most difficult mineral substance encountered.

In some instances, especially in the deeper mines and often the thinner veins, it is possible to undermine the coal by excavating in the underlying strata, consisting principally of fire-clay and sometimes of a dense slaty and rather heterogeneous mass known as "blackjack." In both these materials foreign substances often exist in the form of mineral deposits.

With this foreign matter occurring in irregular forms and in masses of irregular distribution it will at once be recognized that breakers are ahead of the designer, and that good engineers have been baffled in this field is not a matter of so much surprise.

Successful excavating machinery for bituminous coal is destined to be the product of an evolution, the result of accumulated experiences from various sources and districts, derived principally from the carefully observed action of machines in operation, as well as the no less perfect miner, to whose tender mercies the result sometimes of months of work and patience is to be intrusted. This cannot be done by proxy. The environments and conditions are often far from inviting, nor are they entirely free from danger. There seems, however, to be no shorter cut to success. The widely varying systems of mining employed in the different districts still farther renders any single machine which is equally well adapted to all difficult of construction. Such a universal machine is, however, none the less desirable and is doubtless approached most closely by the direct blow or reciprocating action, imitating in this feature the time-honored pick, placing a force behind it never before obtainable. Such a machine may be perfectly guided and directed while in operation. It is the only machine that may be used under almost any condition or quality of coal, foreign substances, underlying strata, or system of mining. It may be used for entry driving, undercutting digging, holing or shearing. It may be well here to give a brief statement of the different systems of operation usually met with in the bituminous mines.

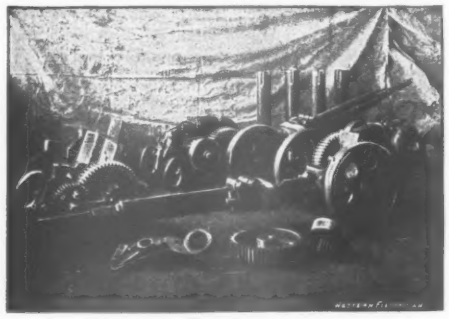


FIG. 3.

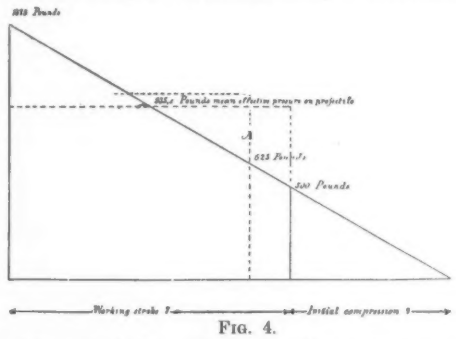


FIG. 4.

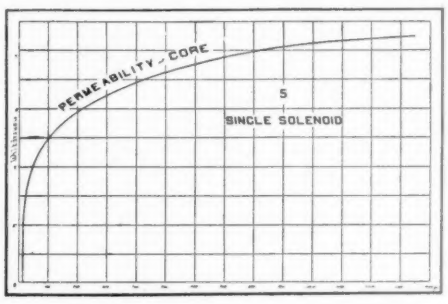


FIG. 5.

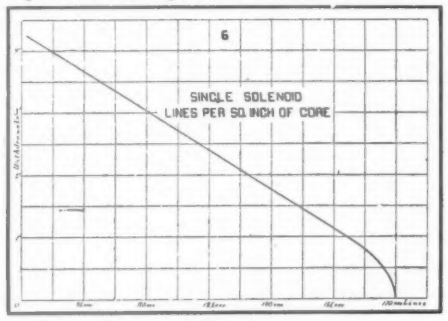


FIG. 6.

After coal is reached, the slope or shaft is divided for ventilation, the air reaching the vein through one division and being exhausted through the other. At this point two or three parallel entries are driven with "break-throughs," at intervals, so that the air may be conducted to or near the heading, and at intervals laterals or "butt entries" are driven usually at right angles to the main entrance. These butt entries are also driven in pairs, and "overcasts" or "undercasts" are used to connect from one of these entries to the remote main entry. Connections are made through the pillar between these entries in the same manner as in the main entries, multiple distribution being employed throughout. From the butt entries rooms are turned narrow at first, but widening out from 20 to 60 feet, according to the nature of the roof, leaving a solid pillar of coal between the adjacent rooms approximately equal to the width of the room. As the rooms grow deeper the ribs are broken through for the purpose of ventilation, and curtains are hung in the butt entries which force a small amount of air down through one room, and out through the next, etc. Rooms are usually driven to a depth of 100 yards. It is in these rooms that the mining operations go forward. The product is loaded into pit cars and thus reaches the surface. In rare instances the roof will allow of a number of these rooms being thrown into one, giving a long face of several hundred feet. This is called a "modified longwall" system, as a part of the mine is usually worked ordinary "room and pillar," and in a few places the extended facings are found. In some instances the measure is so dense as to render undercutting out of the question. In these mines the coal is blasted "from the solid" as in anthracite mining. This, however, is not considered good practice in bituminous mines as the product becomes "powder-shot." The slack in this method will run as high as 50 per cent. of the product, and the lump will not bear shipment or the weather without crumbling.

The system of mining employed at the breast consists of excavations in the coal or in the underlying strata to a depth about equal to the height of the vein, then by boring near the roof holes 7 to 15 feet apart, in which light powder charges are exploded for the purpose of tipping out and bringing down the entire breast, which is still farther broken by picks and loaded into cars. After being undermined, in some instances, the coal is difficult of dislodgement, owing to adherence to the ribs or lateral pillars of the room. To provide against this, machines mounted on high wheels are used to shear in at each side a depth of four or four and one-half feet from the floor to the ceiling, so as to entirely separate the portion undermined from the pillars at each side. This operation of shearing when the sulphurs is sometimes exclusively employed are too numerous in the lower strata. The rooms in this instance are sheared in at either end, and sometimes in the middle, and the coal is brought down by drilling in at an angle and blasting.

Another system of mining prevalent in the northern district of Illinois and in isolated cases in Iowa, Missouri and Western Pennsylvania, is the "longwall" proper. This is among the modern methods of mining. From the shaft "bottom" single entries are driven in four directions through the vein to a distance of about 100 feet, then laterals are taken off each way and driven until they meet. This leaves a pillar of coal to support the top works about 200 feet square. This pillar is never interfered with. After the circuit is entirely completed around this pillar the work is pushed forward on all parts of the facing simultaneously, all the coal being removed; no coal being left, the roof is meanwhile supported

by props, until at last it gives way and gradually settles down, crushing the props, no matter how numerous or how strong they may be. At the same time the floor of the mine "heaves" until the roof and floor practically meet. The rock is taken down overhead in the entries, so that the entries practically consist of tunnels excavated in the "top rock." The longwall facing is pushed forward at all points equally distant from the "bottom," the solid vein of coal ahead supporting the roof in the immediate vicinity, but back from the face a few feet the roof gradually descends until the roof and floor meet, crushing, as it would seem, the forest of props that is used at the face entirely out of existence.

The ventilation in this system consists in dividing the air in multiple, taking it up alternate entries and after traveling the face bringing it back through others, which are brought together near the "bottom," to the upcast, at which point large furnaces or mechanical ventilators are employed for keeping the air in constant circulation.

Roadways driven off from the main entry like veinlets of a leaf reach the facing about every 50 feet. The distance between any two of these face entries is called a room and is worked by two miners. The rock taken from the roof to gain extra height in the entries is blocked between the floor and the roof near the face, leaving a space for the miners of but from two to three feet from the face. The extreme smallness of this working space may be well understood when it is considered that the thickness or height of the vein is sometimes as low as 18 or 20 inches. Wherever a point of sight may be obtained from these facings back toward the main entries the roof can easily be seen bending downward. The "top rock" is fractured and must be supported at numerous places by props and cap pieces, driven in place by heavy sledges. Back a few feet from the face the crushing effect of the enormous weight above can be seen upon these props. The bodies of oak trees six to eight inches in diameter may be seen forcing themselves into the solid rock and curling over at the extremities, exhibiting graphically the enormous pressures of work upon them. Falls of rock are frequent and constant vigilance is the price of safety at the working face in a mine of this character.

The excavating process consists in undercutting in the coal or underlying strata of clay to about the depth of the thickness of the vein, and allowing the constantly descending super-strata to break off the projecting portions of the undermined coal; that occurs from 30 minutes to two hours after the undermining process is completed.

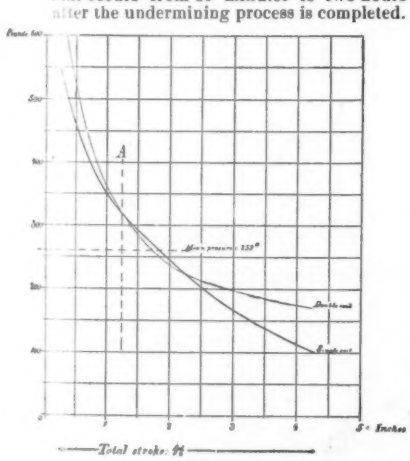


FIG. 9.

This is still further broken up by picks, and loaded as described above. Drilling or blasting is very seldom resorted to in this system of mining.

I have thus briefly pointed out the methods employed that the conditions may be better understood in the discussion now to follow of electrical machinery as adapted for use in such mines. A diagrammatic outline of the direct blow machine is shown in Fig. 1. The completed machine and parts being shown in Figs. 2 and 3. In this form of machine a bi-wheeled truck, furnished with handles at the rear, is provided with a continuously operating electric motor of about four horse power, connected by gearing to a catch or retractor; a longitudinally moving heavy projectile with a pick secured to its outer extremity is surrounded by a driving spring of about 125 pounds per inch compression. The line of movement is practically through the center of inertia of the machine. These springs are preferably made in sections, and initial pressure is given of about 500 pounds. A retraction then takes place of from 6½ to 7½ inches to a pressure of 1,875 pounds, whereupon it is released and allowed to make a vigorous forward stroke. This process is repeated from 160 to 225 times per minute. The mean effective of this type of machine is 935 pounds when allowed to strike the cushion, and when striking the work at a distance of one inch from such cushion giving 1,000 pounds mean effective. This is shown in the spring curve diagram Fig. 4. The mean effective in air machinery employed for the same purpose is between 400 and 450 pounds, a 8¾-inch cylinder being the largest employed. The current required for the operation of this machine is between 10 and 10.2 amperes at 220 volts. The projectile weighs between 100 and 150 pounds in the different sizes of machines. Early in the development of this machine it was found that under the action of the intense concussion resulting from the percussive blows and shattering strains throughout the machine, a motor to last under such conditions must be essentially different in its organization from the ordinary commercial machine. After working along various lines it was at last found that by mounting the driving pinion loosely upon the armature shaft, providing it with wing-like projections, between which and the armature shaft elastic cushions, such as blocks of rubber, could be inserted, the trouble could be averted, and, when adopted, it was found that the repairs on armatures were reduced to a small percentage of their former value. An elastic medium was also employed in the commutator to account for the difference in expansion of the insulated copper segments and the steel commutator shell. Numerous driving keys or fins, consisting of rawhide, were set in the periphery of the armature and allowed to protrude for the purpose of securing the coils against circumferential displacement. The fields were not found to give trouble. With this construction of armature a large number of machines have been made and run successfully in mines in Illinois, Indiana, Ohio and Kentucky. In most instances these machines are run constantly night and day.

A detailed report of each day's work of these machines has been kept from the very first, stating the exact nature of any repairs, the name of the "machine runner," the number of feet undercut, hours' work, etc. These reports are kept on file, and have been of great value in aiding to eliminate the troubles developed. In Ohio, alone, these reports show that upward of 550,000 square feet of coal strata have been undercut by this type of machine. A somewhat larger amount than this has been excavated in Illinois. In the States of Indiana and Kentucky the operations have not been of so long duration, but at present the daily cutting in the latter States exceeds those in the former.

Beside the elasticity introduced in the armature gear, elastic cushions have also been introduced between the retracting device and the main gear, which is found to still farther reduce the shock to the machine. At an early date it was found that a machine capable of storing in each stroke of the heavy projectile as great an effort as is required for rapid and effective cutting must, of necessity, be heavy to be capable of backing up the blow without serious recoil, yet the machine, on the other hand, should be light for easy handling and direction by a single operator. With a light machine it is found impossible to allow the cutter to strike the work sufficiently back in the stroke for its required penetration without serious effects from recoil. The operator would complain bitterly of the machine running back upon him, jerking him about upon the floor of the mine, making accuracy of direction impossible, yet lightness of the machine is important. To combine both qualities I devised a cycle of operation shown in the diagram, the object being to immediately start upon the act of retraction at the moment the projectile had been arrested by the work, no matter at what point in the stroke, eliminating thereby the time element necessary for overcoming the inertia of the body of the machine and starting it backward in recoil by the intense backward spring pressures. The details are simple and will be readily understood. The projectile *A* is forced forward by the spring *B;* a cushion *C*, relieves the shock when the projectile is not otherwise intercepted. A gear wheel *D* is constantly driven in the direction of the arrow by the motor pinion *E;* this wheel is provided with internal ratchet teeth *R*. A crank *G* is mounted entirely free from the wheel and co-operates with a long slotted pitman *H* connected with the projectile for retracting the same. A light steel crank arm is pivoted entirely free of the wheel *D*, and an auxiliary arm *I*, provided with a dog co operating with the ratchet teeth *R*, is pivoted to the main crank arm at point *J* and connected with the crank arm through the circular steel spring *K K*. When the crank *G* reaches the back dead center at point *m* a reversal of the strains and a free forward movement occurs in the direction of the rotation of the wheel, but very much faster under the impetus of the heavy compression of the driving spring *B*, the pitman and both portions of the crank moving forward together. Suppose, now, that the forward stroke was intercepted at point shown in dotted line near the letter *A*; at this moment the crank *G* would be found in the position *X*, also shown in dotted lines, but its momentum and the slot in the pitman would instantly allow it to take up position *Y*, also shown in dotted lines, being at an equal angle on the opposite side of the center. Its further progress would be intercepted by the remote end of the pitman, and at this instant the dog would instantly fall in the next tooth in the revolving wheel *D*, immediately commencing its work of retraction without the necessity of the full stroke of the pitman being accomplished. The work of the percussive blow is fully accomplished before full retardation and while being intercepted. Nothing is accomplished by standing and pushing against the face so that its immediate retraction is not found to interfere in the least with its effective operation, but, on the other hand, is found to eliminate entirely the serious effect of recoil upon the operator, allowing a light machine to be easily and completely directed while at work. Modifications of the details have been employed, but the general principle has been found to work extremely well in practice. The machine efficiency from the current on the one hand, and the blow of the pick upon the other, has been found to be in excess of 70 per cent.

Another form of the direct blow machine has been constructed operating upon the solenoid plan; two and three solenoids have been employed in various combinations. It has been found that the return of energy was extremely small until an approximately close magnet circuit was reached Another point found was the effectiveness of the blow was materially decreased if the magnetic circuit was closed beyond a certain point, the reciprocation of the solenoid core being dependent upon the non-closure of the magnetic circuit. Diagrams are submitted herewith showing the various mathematical functions of the machine.

In the plates 5 to 8 the ordinates show different withdrawals of the core, and the abscissæ show other functions named in the diagrams. The pressure obtained in case of both single and double coils are shown in diagram No. 9. Plate No. 10 indicates the general arrangement of the solenoid machine. The total weight was about the same as the weight of the spring-actuated machine, and the energy absorbed somewhat in excess. The mean effective pressures, however, are not nearly as great, as diagram No. 9 indicates; especially is this the case when the work was intercepted, say, one inch from the end of the stroke, as at point *A* in diagram; the mean effective pressure

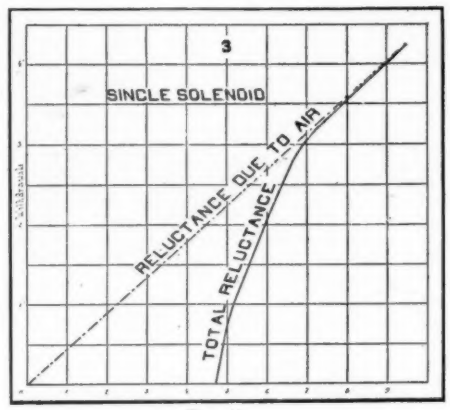


FIG. 7.

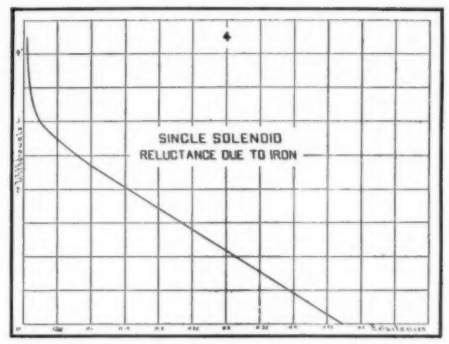


FIG. 8.

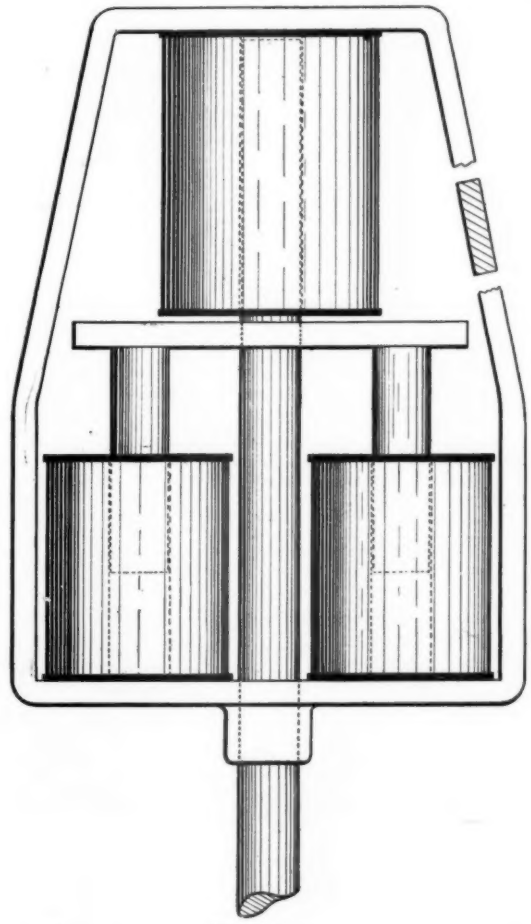


FIG. 10.

falls from 259 to 210, decreasing, instead of increasing, as in the case of the spring machine. It was possible to recover in the solenoid machine nearly 10 per cent. of the energy expended during the first few minutes, but the heating effect was found to seriously interfere with its protracted operation.

In drilling holes for blasting, an auger machine is used, shown in Plate No. 11. In this case the auger is driven by a single reduction motor, the rod holding the auger being provided with a featherway for driving and a screw-thread for the feed. An automatic attachment is placed upon the nut of this screw feed, by means of which, when sulphurs or other foreign substances are encountered, the feed is automatically relieved, the progress being inversely to the density of the strata. The machine is made light, and is usually fastened from roof to floor. One machine will drill about 50 holes six feet deep per shift of nine hours. The speed of its penetration in ordinary coal is about 3½ feet per minute. It requires about 3½ amperes at 220 volts. Both this and the pick machine are provided with a starting rheostat combined with or located interior to a cable reel which accompanies each machine. The flexible cable reaches back from the machine to the wires in the entries. The core of this cable is small, and although insulated clamps have been persistently shipped secured to the ends of the cable for its attachment to the entry wires, it has been found that the miners almost invariably cut them off and prefer to simply bend the end of the cable in the form of a hook, and hang it upon the entry wire. This allows of their being readily pulled off upon the completion of the work without the necessity of going back to the mouth of the room, and at the same time seems to provide all the contact required.

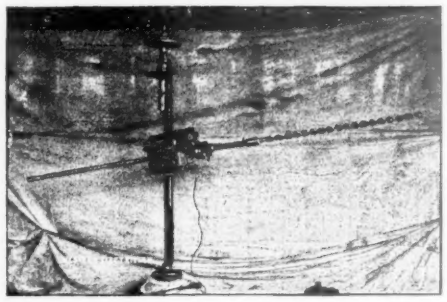


FIG. 11.

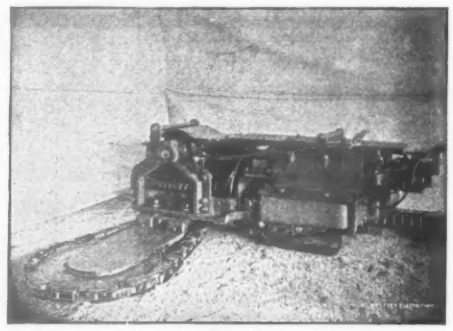


FIG. 14.

As to other machines, it may be stated that they are divisible into two general classes—the revolving cutter and the chain machine. In the former the cutters are secured to a revolving bar, which is forced against the substance to be cut. In the latter the cutters are inserted in a chain running over suitable sprocket wheels fastened to a frame, which extend under the coal supporting the entire cutting organization. The chain, as it passes out from the coal, goes around a driving sprocket from which the power is obtained. Many attempts at the construction of the former class of machines have been made, which have resulted in entire failure. From my own observation and experience I have found the following to be true with reference to this class of cutters. In diagrams Nos. 12 and 13 an outline view of such machine is shown. *A* indicates a rotating cutter bar; *B* the journals of such bar; *C C* the knives or cutters secured to such bar; and *D D* is the coal strata in which the cut is being made. It will be noticed that immediately before the journals, where it is impossible for any cutters to be located upon the bar, there is a solid pillar of coal left. This must be broken up and dislodged by sheer forward pressure of the end of the journal. Furthermore, if foreign substances are encountered by the bar, the cutters are usually entirely stripped off at this point. This leaves a pillar uncut as illustrated in the figure, which makes further progress entirely impossible until the machine is withdrawn, new cutters inserted, and the pieces of the old ones carefully removed from the kerf. If the machine is not of great strength, other portions sometimes break on these occasions, and the machine is laid up for a number of hours and even days for repairs. I have found that in using a chain, as shown in the plates of the longwall machine, now to be described, if some of the cutters are broken others immediately take their place, and the cutters upon the chain will continue to attack and finally dislodge the foreign substances; in any event the chain will continue to cut so long as any teeth are left upon it, and their absence is easily observed by the operator, inasmuch as all the points in the chain are constantly passing any point of observation outside of the kerf.

The extremely small amount of room between face and props in the longwall mines sometimes precludes the possibility of even using a very short reciprocating machine. I have, therefore, resorted to another form of machine, shown in plate, to be used in connection with this style of mining, consisting of a mechanism about five feet in length, about 20 inches wide and 18 inches high, from the side of which protrudes a cutting device operated by an electric motor forming part of the machine. This is organized to travel along the face and undermine to a depth of three feet, usually working in the strata below the coal, known as "fire-clay," samples of which are on the table.

A number of these machines are in daily operation in the northern district of Illinois.

ROTATING CUTTER BAR MCH.

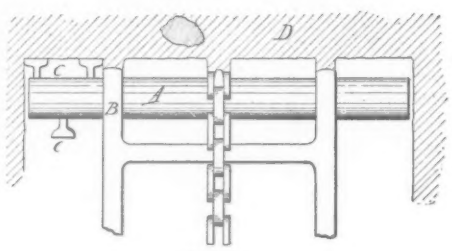


FIG. 12.

ROTATING CUTTER BAR MCH.

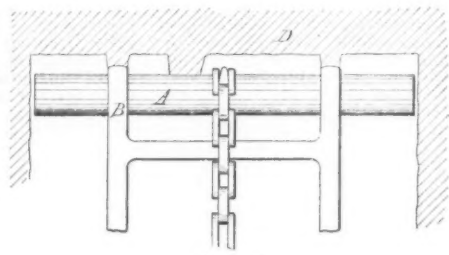


FIG. 13.

A single machine has repeatedly undermined as high as 1,500 feet in nine hours. The machine weighs somewhat over a ton, and travels upon a rail located at one side, which at once provides support for the machine, means for providing against the twisting strains of the lateral cutting device, and providing at the same time for feeding in either direction. These rails are in sections and are taken up after the machine has gone over them, are passed to the front over the machine on rollers provided for the purpose and are laid ahead. The pintles used to connect the rails form, with the other pintles, members of a series by means of which the feeding along the rail is effected in a simple manner, and one that has proven successful in actual work extending over a considerable period of time. The machines are shown in photographs presented herewith, and have been in use upward of two years. They require 22 to 35 amperes for their operation at 220 volts. Flexible cable of 150 feet is provided, which, being attached to the live wires ahead, allows the machine to cut 300 feet before readjustment is required.

After the product has been loaded and the cars massed in trains, their transit to the surface is a problem that has received considerable attention from the mining engineer. There are three prominent systems of mechanical haulage in operation. One in quite extensive use is the tail-rope system, where a main traction rope leads out from a drum over numerous pulleys and rollers to the front of the train. A tail rope of lighter weight leads from another drum on the same shaft over numerous grooved shives at the side of the track, or suspended from the roof over a "bull-wheel" at the further end of the track, coming back upon the track-rollers and being secured to the rear of the train. Each of the drums is detachably secured to the driving shaft of a powerful engine. The train is only under control of the distant engineer. A trip rider usually goes with the train, and a rather complex system of signals is employed by means of which he may possibly communicate with the engineer.

Another system of growing importance is the endless rope, which consists of a slowly moving wire cable usually requiring double track, and double-width entries single loaded cars or trains being coupled to the rope by grips at the inner end, which are disengaged at the receiving end and attached to the "empties" standing upon the other track, and are thus gripped to the outgoing cable and sent on their way back. A large number of extra cars are required, owing to the slow movement of the cable. In some instances trip riders are employed to accompany the train. In some mines grip cars are used. In both of these systems a large amount of power is expended compared to the work performed, and the speed is of necessity limited. Another drawback is the excessive complication necessary in track, innumerable rope sheaves, timbering and entry to provide for turnouts, crooks, cross-overs, ventilating traps, etc.

Electric haulage has been looked upon by the foremost operators as the coming system, and one which is destined to solve the problem of economical transfer of the heavy product in mines. In studying the problem of electric haulage for mines one is met with the fact that the tracks are poor and light, the road-bed is crooked and irregular as to levels and generally of light construction. The curve, owing to the necessity of leaving pillars, and having connected sight entries, admit only of small radius curves, and excessive grades are often met with in the dip of the vein which cannot be obviated by cuts or fills, as on surface roads, without great expense, especially if the entries are timbered, which is usually the case in Western collieries. Yet a service of the highest efficiency and greatest capacity in speed and tractive power is required. The motor must work double shifts if necessary, and be at all times under perfect control of a motor man receiving $2 25 per day, and never fail for an instant.

After considering the problem, I have designed a motor shown in the accompanying photographs. A number of plants containing this motor are now in daily operation in Ohio, Indiana, Kentucky and in this State (Illinois). Two of these plants have been installed in one mine in Illinois. Profiles of the entries in which these cars are in operation are represented in Fig. 16. These show grades as high as 7 per cent., 5 per cent. being not unusual.

The matter of stability of road-bed is a relative one. There are conditions under which a 10 pound rail would be as stable for a light locomotive as the New York Central's 100 pound rail is to the tremendous load per driver in the high speed locomotives recently placed in service on that road. Pounds pull at the draw-bar is only obtainable by pounds weights at the rail, yet for a heavy draw-bar pull it is not necessary to have the weight upon any one driver excessive. In designing the locomotive I have employed eight drivers, grouped in two swiveling trucks, free to turn on the shortest radius curves, as short, in fact, as nine feet radius, measured from the center of the track. A single powerful motor, constituting the frame of the car, is coupled to all eight of these drivers, the coupling being simple and of such character as not to be interfered with in the least by the change of alignment between the truck and the car body upon irregular track or in making curves. This, while being rather a difficult problem, has been successfully worked out, as shown by the fact that none of the locomotives have ever required repairs as to this portion of their mechanism, although the first has been in operation about two years. Fig. 16 illustrates the central feature. Steel tires of a special grade are employed on all the drivers, and the fact that they are driven from a single motor insures absolute uniformity and harmony in their peripheral speed. It is to this fact, as recently stated in a paper before the Chicago Electric Club, that I attribute the extremely satisfactory results in traction which have been observed, it being demonstrated both in shop tests and under conditions of actual service that two motors without mechanical coupling do not show results that are at all comparable. In regular service as high as 25 per cent. of the weight of the entire machine may be depended upon for draw-bar pull, and considerably over one-half of such weight has repeatedly been shown on the dynamometer. The wheel base is entirely flexible, distributing equal portions of the total weight upon each driver under all conditions of irregular track. The trains hauled by these locomotives frequently have as high as 200 wheels upon the track. The pit car wheels are constantly oiled, distributing an excellent lubricant from one end of the track to the other, and I have found for rapid acceleration work on heavy grades, and quick action of the brakes, that sand is almost as indispensible as the current itself. In using the rails as return the sand is found to seriously interfere with the proper electrical connection

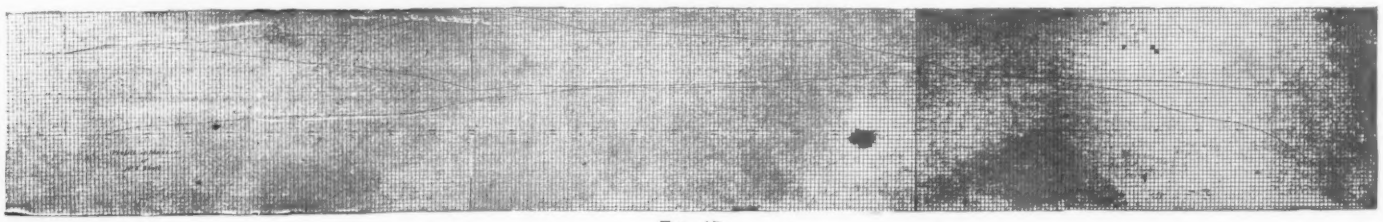


FIG. 15.

with the rail for electrical conductivity. This is an accidental feature in the use of

the eight wheel car which is of great value. The machines themselves are low and narrow, the height being between 34 and 36 inches, accommodating themselves thereby to the lowest entries. Three sizes have been built, namely, 8, 10 and 12 tons, see Figs. 17, 18 and 19. The motor of the largest of these is of 125 horse-power capacity; 250 volts is the highest that has been used in connection with the machine. The temperature of the machine is very low, not exceeding 60 degrees above the atmosphere on a 10 hour run. These machines have been operated on as low a rail section as 10 pounds with fairly good results. The heaviest rail that has ever been employed in connection with them is 20 pounds. This makes an extremely inexpensive track, not only eliminating entirely the light track argument used against electricity by advocates of rope haulage, but "sees them one better" in that a single track with the most abrupt curves serves better purpose than double track with rope. In Streator No. 3 shaft of the Chicago, Wilmington and Vermillion Coal Company a round trip on a haul of 7,000 feet, including switching at both ends, has been repeatedly run in eight and one-half minutes, part of the entry being a three per cent. grade against the loads. Thirty-seven pit cars of about two tons gross weight have been handled on this grade. The controlling mechanism is extremely simple, a single hand wheel serving the purpose of start, stop, acceleration and reverse. A rheostat and series fields are used. The rheostat is of most durable construction, consisting of iron and asbestos. The trolley wire is upon the roof and follows the line of the track at a distance of about six inches outside of the gauge line of one of the rails. Excellent results have been obtained by the use of an elastic medium being located between the trolley wire and the solid mine roof, one form used being among the exhibits. The elasticity prevents concussion of the rapidly moving trolley, obviating thereby the serious sparking often and most easily observed in mine entries where nothing but the most intense darkness prevails. To my mind the extreme facility with which electric power can readily be transmitted by the mere contact between conductors has no parallel in any branch of physics. I have often observed the simple contact between trolley wire and and wheel while 160 horse-power, namely, 480 amperes, were being transmitted to the motor, each of the eight drivers slipping vigorously on the sanded track, throwing fire which illuminated the surrounding mine walls, while the trolley, with the exception of slight infrequent scintillations, was perfectly dark and of extremely innocent appearance.

A number of special and automatic devices have been employed in connection with the system with excellent results. Powerful

FIG. 16.

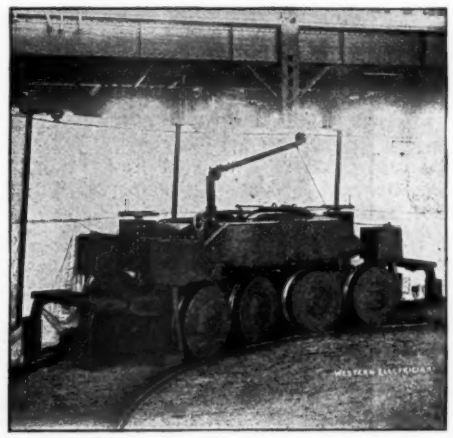


FIG. 18.

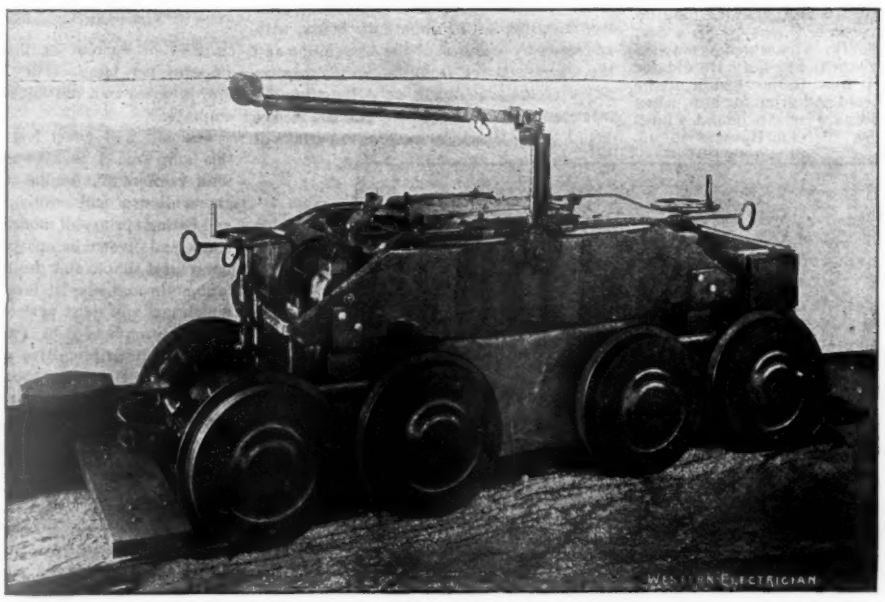


FIG. 17.

electric headlights are used in each end of the locomotive, and in the 12 ton type (see Fig. 19) the end is carried out, providing a cab which entirely surrounds the motorman with high walls of metal two to three inches thick, entirely protecting him against collision, piling up of cars, falls of rock, etc. I have operated this motor on tracks which, if seen by daylight, would be adjudged unsuitable entirely for even the roughest mule service, handling heavy trains at a rate of speed of 2,700 feet per minute, being somewhat over 30 miles an hour. The perfect flexibility of wheel base of the motor is doubtless responsible for these excellent results. Compound-wound dynamos of about seven tons weight are used to furnish current for the machine (see Fig. 20). These are designed for sufficient excess of capacity to operate other devices in connection with the mine. In one mine at the South we have coupled to a single dynamo and engine one of our eight ton haulage cars, electric lights at all partings and switches, and on top in engine room and at a store, electric mining machines of the direct blow type, and an electric drill for blasting, by means of which machines the entire product of the mine is taken out. The mine, which was formerly ventilated by a furnace, at present has its air moved by a fan driven by a powerful electric motor, and an electric pump is at present being installed, all of which are operated from the same feeders.

In Kansas a mine pump raising water about 800 feet and two very extensive endless rope hauls are operated from the same dynamo as our electric excavating machinery. The pumps are of simple construction, the motor being geared to the plungers by spur gearing. It has been found with the pumps, longwall machines and drills, as well as in the case of the percussion machines, that mounting the pinion loosely upon the armature shaft and driving it with cushions located between it and the armature, has worked a decided economy in repairs, showing its adoption to be along the line of good engineering.

Thomson-Houston Dividend.

According to the Boston *News Bureau*, the declaration of $1.20 per share upon Thomson-Houston stock, payable August 1, instead of the usual quarterly of $1 was made to even up the returns to stockholders upon the basis of the consolidation with the Edison Company.

The Kings County "L" Road Company, of Brooklyn, N. Y., intends to adopt electricity as a motive power on its system. General Jourdan said last week that the directors had been discussing two methods—storage battery cars and the trolley system of propulsion. They favored the storage battery method, and General Jourdan said the change would be made before long. No definite decision as to what system will be used has been arrived at.

The Future of Electric Railways.

Though there is reason to think the electric will not replace the steam locomotive on ordinary railways, there can be little doubt that all underground and, perhaps, open-air suburban railways will soon be worked electrically, says London *Industries*.

So far, we believe, there is only one underground railway in existence in which electricity has been adopted exclusively, and that is the City and South London Line. This is to be the forerunner of several others, no fewer than six bills having been introduced into Parliament this last session. The original idea was to use cable traction, but on further consideration it was decided to adopt electric traction, and a complete system designed by Messrs. Mather & Platt, engineers, of Manchester, was adopted. The locomotives were to be designed for drawing trains consisting of three carriages accommodating 100 passengers and weighing 4¼ tons each, and the generating plant was to be sufficient for working a service of 20 trains per hour. A contract was entered into with Messrs. Mather & Platt in January, 1889, and their guarantee stated that the cost of haulage, exclusive of drivers' wages, should not exceed 3½*d.* per train mile for the maximum service proposed, viz., 384,800 train miles in the half-year, and according to a sliding scale if the mileage were more or less, increasing to 7½*d.* per train mile for 188,666 miles, the actual mileage accomplished.

On December 18, 1890, the line was opened for public traffic, and has, therefore, completed 18 months' running. During this time Messrs. Mather & Platt's locomotives have run more than 500,000 miles, and have provided for a traffic of more than 7,000,000 persons, but this statement alone does not fully represent the work which has been demanded from them. Owing to the carriages being made stronger and heavier than originally designed, the actual weight of each carriage being 7 tons, instead of 4¼ tons, the weight of the loaded trains was increased to 42 tons, or more than 40 per cent. heavier than the trains for which the locomotives were designed. Of this great increase in the loads which their locomotives were to draw Messrs. Mather & Platt had no intimation until after all the locomotives were constructed and delivered, and arrangements had been made for the opening of the line. Under such unexpected circumstances the locomotives have at times been overstrained, resulting in delays in the traffic. The wear and tear also has proved somewhat greater than originally anticipated, yet the record of work done by the electric locomotives in comparison with the work done by steam locomotives is very satisfactory. The cost of working has proved equally satisfactory. During the second six months of working, according to the published half-yearly accounts, the cost of locomotives and generating power, including wages, repairs and renewals, amounted to £6,199 for a mileage of 188,666, or less than 8*d.* per mile. If allowance be made for drivers' wages, which were excluded from the original estimate, this is equivalent to about 5½*d.* per train mile, 25 per cent. less than the amount guaranteed by Messrs. Mather & Platt, although the weight of trains had been increased 40 per cent. These facts are the more striking when the difficulties of adequate and regular inspection of the rolling stock of a line entirely underground are considered, difficulties which do not obtain in the case of any ordinary railway, and when it is further remembered that the entire system of working was novel, to which the employés of the company were unaccustomed, and for which they had received no special training.

The distinguishing feature of Messrs. Mather & Platt's locomotives is that the armature is constructed directly upon the axle, and the magnets supported partly upon the axle and partly upon the frame. Probably this design—due, we believe, to Drs. John and Edward Hopkinson—obviating all gear, and reducing the mechanism to the simplest elements, has contributed more than anything else to the successful working. For the heavier trains which will be required for the working of the new lines there will be no difficulty in designing heavier and more powerful locomotives on the same principle. In the schemes now under consideration, Mr. Greathead is proposing larger tunnels, 12 feet in diameter, instead of 10 feet, as in the case of the City and South London Line. This will greatly facilitate the construction of larger locomotives, and more commodious and comfortable carriages, which are the chief points necessary to ensure the success of the new undertakings.

Indeed, there seems little more to work out in the matter of electric railways. The chief improvement that still remains to be made will have for its object the removal of resistances and contact switches. Perhaps the scheme of Mr. H. Ward Leonard, of New York, will come into use. Though it may be somewhat too complicated to find ready acceptance in tramway work, it is eminently suitable for electric locomotives.

The Electrical Time Company, Chicago, has decreased its capital stock from $100,000 to $30,000.

Murat Halstead on Cyrus W. Field.

The following tribute to Cyrus W. Field is from Murat Halstead's editorial correspondence in the Cincinnati *Commercial Gazette:*

When we write that Cyrus W. Field died this morning, we record the close of a career remarkable for its influences and its vicissitudes. Within a few squares—the distance from Washington to Gramercy Park, New York city—are apartments in which Morse perfected the magnetic telegraph and Field conceived the idea, which he executed, of connecting the continents through the ocean by cables, insulating wires for the transmission of electrical energy. The fact that

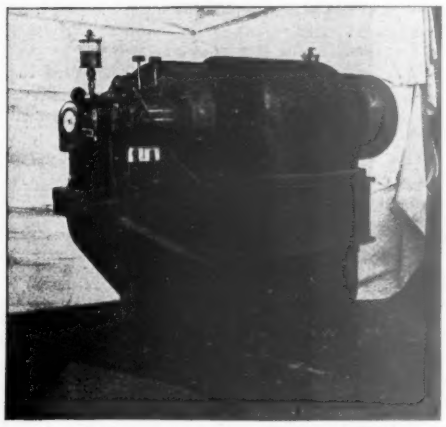


FIG. 20.—ELECTRICITY IN BITUMINOUS COAL MINING.

Field did not invent the wiring of intelligence no more detracts from his fame than that somebody else found the magnetic compass deprives Columbus of his immortal distinction as a navigator. It was Columbus who crossed the trackless abyss, guided by faith and the needle and the stars, and it was Field who saw, as he turned a globe in his study, that the nations could and would and should talk to each other through the mighty waters, and that there was a new world of enterprise to conquer. The conquest was one greater than Alexander sighed for. The victory won surpassed in its utilities the military achievements that are accorded the celebrity that glittered for ages. The hero was the slender, intense, unswerving enthusiast, Cyrus W. Field, who gave to ocean telegraphy 12 years, all crowded with labors that were persistent, ceaseless and vehemently earnest—overcoming obstacles that seemed insurmountable. That which was done was vivid in history and vital in the affairs of the world. Mr. Field's confidence was so great, his will so absolute, that he thought of nothing but the attainment of his object, the laying of a cable across the Atlantic. When success came complete and glorious at last he had everything at stake. Another failure would have swept away his fortune and left him poor as when he came to New York, a tall youth, and walked up Broadway, noticing on a brass plate the familiar name, "Mr. Astor," and finding a situation with Alexander T. Stewart. He believed that the peril he had been in of utter impoverishment was a lesson that would last him through life, and his mind was fertile in plans to make secure against all contingencies a competence for his beloved wife and children. His success with the cable gave him the almost boundless confidence of English friends, and some of them greatly profited by his judgment in the value of American, especially National, securities during the war of our States. He had many English friends who greatly honored him. Mr. Gladstone, the Duke of Argyll and Dean Stanley among them. His closest friends, however, were Richard Cobden and John Bright, and he was a guest of the greatest distinction at the opening of the Suez Canal.

He keenly enjoyed his prosperity and his fame, and if it had been in his nature to live easily and quietly, no man could have had more honor at home or greater affection and admiration; but the same fiery, incessant, consuming executive characteristics that impelled him into and carried him through the cable enterprise were still a motive power that was irresistible. It was not in him to be quiet and contented. Those who were nearest and dearest begged him not to exhaust himself with endless effort, but he was not born to be still. He was one of the greatest travelers of his time. While in command of ample means and leisure if he could have endured it, before he had thought of the cable, he visited South America and ascended the Andes in Peru with Church, the artist. He thought no more of going to Europe than crossing the Fulton ferry. He had spun the magical wires around the earth; made neighbors of peoples living on the opposing shores of the seas; caused the universal diffusion of intelligence about the globe, and he seemed to find possessions that pleased his fancy in the uttermost parts of it. In 1878 he visited Iceland, attending the millennial celebration of the settlement of the island; rode to the Geysers and saw the snows of Mt. Hecla. Subsequently he made a tour around the world, gratifying a long-felt solicitude to put a girdle about the earth before he rested in it. He had early understanding of the elevated railway system of New York, and was as alert and urgent in that as he had been in the cable. He saw that the elevated trains not merely made the upper portion of the island available, but restored the values of the old part of the city near the battery. Hence, the Washington building. Fortune, as if won by his ardor, favored his audacity. That which he touched (land or paper) turned to gold. He did for years live, as it were, in the shadow of the crisis that was cold and grim for him, when the Atlantic cables were at a bound a business success; but his sagacity was so urged on principle, impaired at a time which turned out critical his financial strength, and caused a series of events that strained his resources. He bore misfortune with dignity, as he had gathered harvests of gold without exultation. Mere poverty could never have daunted him. Sorrow alone, however bitter the bereavement, would not have broken him. He bore the hard buffetings of ills and misfortunes from all quarters. His wife, the wife of his youth and companion of all his years of trial, after their golden wedding, surrounded by hosts of friends, died. A daughter, long an invalid, became insane, and the daughter upon whom he leaned died. His sons failed terribly in business, and behind that was the ghastly shade of insanity; and then the death blow came in the charges that there was in transactions involving the name whose brightness it had been his pride to cherish the presence of that which seemed to him the impossible and the intolerable. It touched him not; there was the glare of lunacy, rather than the stain of dishonor in it; but it was a mystery and a horror, and the man whose name will live among the few who have conferred upon their race affluence, whose reputation is immortality, has died, heart-broken, seeing in his delirium not the triumph of dazzling accomplishment, but only the perplexity of the long agony of strife. There will be an awakening in his honor. Let us trust a ray of kindly light may enter and disperse forever the darkness that was upon him; and now the old words, so appropriate that they glow as if newly coined, come with the comfort at least of philosophy—"Life's fitful fever o'er, he sleeps well."

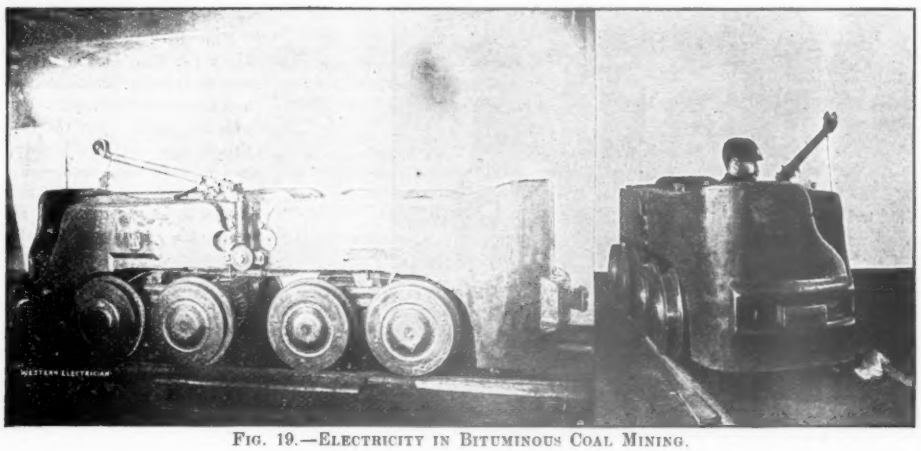


FIG. 19.—ELECTRICITY IN BITUMINOUS COAL MINING.

Third Annual Meeting of the Massachusetts Electric Lighting Association.

At Hotel Pemberton, near Hull, Mass. (Boston Harbor), Tuesday, July 12, the Massachusetts Electric Lighting Association held its third annual meeting. President F. H. Gilbert was present and presided with his customary grace and parliamentary skill. Sixty-five members were in attendance together with 20 invited guests. Among the latter were several representatives of gas companies of the State. Following the usual preliminary business, the question of admitting the Gas Companies of the State to the association was introduced, and after some talk on the subject, the motion was unanimously approved and the name of the association and by-laws changed.

Hereafter the name of the organization will be that of the Massachusetts Electric and Gas Lighting Association.

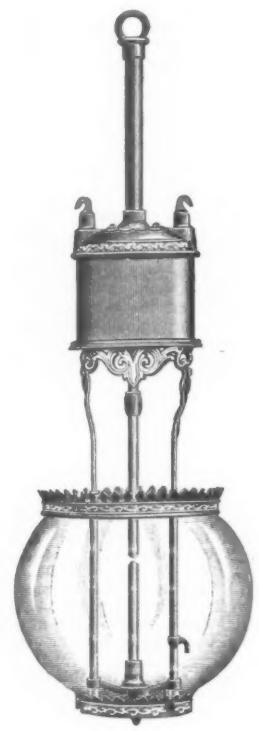
The old officers were re-elected unanimously. After an interesting and instructive meeting, lasting about two hours, with addresses by members of the Association and the representatives from the gas companies, adjournment was made only for those in attendance to meet again around the festive board of the Hotel Pemberton, to partake of a substantial fish dinner and other good things too numerous to mention. After the dinner was over, a social chit-chat was indulged in for awhile by those present; and before one thought of taking his departure from the pleasant gathering, it was announced that Mr. C. L. Edgar, of the Edison Electric Illuminating Company of Boston, had kindly responded to a request to talk on the subject of "Small Electric Motors." The address was brief, yet very comprehensive and entertaining to every one present and was loudly applauded.

It had been previously understood that Captain Wm. Brophy was to be present at the meeting and read a paper on "Insurance and its Relations to Electric Lighting," but this was prevented by death in Capt. Brophy's family, which was deeply regretted and sympathy expressed by all present.

The Association has been growing slowly, yet surely, and now, with the additional influence and members afforded by the extensive gas interests of the State, it cannot fail to become one of the largest and most powerful organizations in Massachusetts.

The Kester Arc Lamp.

The illustration presented here shows an arc lamp for constant potential circuits and can be run on any incandescent light on 500 volt street railway circuit. The lamps will burn two in series on any circuit from 100 to 150 volts and hold a steady arc with seven



THE KESTER ARC LAMP.

amperes of current or three and one-half amperes per lamp. They will also burn four in series on a 220 volt circuit with seven amperes.

The new and novel features claimed for this lamp are: A positive clutch mechanism with a differential double stirrup, also a single armature and clutch-releasing device and lifting spring, all mounted upon a single frame and pivoted at one point, making the lamp most simple and desirable. The insulation throughout is lava and porcelain, which makes it most perfect.

The clutch is of a heavy block of bronze metal and its grip positive and cannot raise without bringing the carbon rod with it.

This lamp is manufactured by the Kester Arc Lamp and Manufacturing Company, 173 South Canal street, Chicago, with J. F. Kester, formally of the Kester Electric Company, Terre Haute, Ind., as president and general manager. Although but recently organized, the company is doing a fine business and the lamps are giving the very best satisfaction.

New Iron Buildings.

The Berlin Iron Bridge Company, of East Berlin, Conn., have received the contract for the new tin plate works which Hughes & Patterson are to erect at Philadelphia, Pa. The buildings will be of iron from the designs of the Berlin Company. The main building will be 40 feet wide by 253 feet long, with a wing of the same width 300 feet long, both two stories high. The rolling mill will be 120 feet wide by 160 feet long, with an annealing room 75 feet wide by 160 feet long. The whole plant will require about 800 tons of iron to be used in its construction.

ADVANCE INFORMATION.

New Electric Companies Formed and Important Constructions Projected.

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week:

New Electric Railways.

CHELSEA, VT.—The town has voted unanimously to have an electric railroad from South Royalton to Chelsea.

VANCOUVER, B. C.—It is reported that the Canadian Pacific Railway has decided to build an electric line from Vancouver to Lulu Island, a distance of 12 miles.

ST. LOUIS, MO.—Drake & Orton, railway contractors, of Chicago, are interested in a company organizing for the purpose of constructing an electric railway from St. Louis to Webster Grove, Mo. It is estimated that $450,000 will build and equip the line.

CHICAGO, ILL.—At a meeting of the Board of Directors of the Elgin, Aurora and Fox River Electric Railway Company, held in this city, the following officers were elected: William Grote, Mayor of Elgin, Ill., president; John M. Egan, vice-president; Henry A. Gardner, secretary; Henry H. Evans, treasurer; Arthur M. Beaupre, auditor; T. E. Ryan, general solicitor. Books of subscription to the capital stock were opened, and steps were taken to secure the right of way and begin the construction of the road at an early date.

MUNCIE, IND.—The Delaware County Land and Improvement Company is an applicant to the Common Council for a franchise to build and operate an electric car line in this city.

AKRON, O.—The bonds of the Akron-Silver Lake Electric Street Car line have been floated in New York, and the line will be built immediately.

OAKLAND, CAL.—G. W. McNear has filed a petition for a franchise to build a street railway and to operate thereon cars propelled by electricity.

CINCINNATI, O.—L. A. Russell, Albert L. Johnson and Sidney H. Short, of Cleveland, O., have applied to the Board of Legislation of Cincinnati for a franchise to build an electric line to Price Hill in Cincinnati. It is stated that they propose to spend $2,000,000 on the route contemplated if the authorities grant the application.

SHARPSBURG, PA.—Another electric railway for this town is projected.

NEW BEDFORD, MASS.—The Union street railway is to be transformed into a first-class electric railroad if the new management can secure permission from the board of public works. J. Irvine, of New York, who represents the syndicate which will purchase the franchise of the railway, says that there have already been deposited 2,451 shares of stock.

NEW YORK CITY.—The Harlem Bridge, Morrisania and Fordham Railway Company, the Melrose and West Morrisania Railroad Company, and the North Third Avenue and Fleetwood Park Railroad Company have been consolidated and will hereafter be known as the Union Railway Company. The lines will be operated by the overhead trolley electric system.

ROCHESTER, N. H.—The citizens of this city are at present very much interested in the proposed scheme to connect Rochester, Dover and Great Falls by an electric railway. H. W. Burgett, of the Union Street Railway, of Dover, is at the head of the venture.

PITTSBURGH, PA.—A company has been organized in Pittsburgh for the purpose of building an electric street railway, with Tarentum and Natrona as the termini. Howard Wheeler, Edward Waters, Pittsburgh; J. C. Breckridge and James Lane, Tarentum, compose the company.

PHŒNIX, ARIZ.—The city council has granted two franchises to build electric street railways. One was granted to San Francisco capitalists and the other to Lem Harrison, of Denver, Col.

ALTON, ILL.—The Alton and Suburban Electric Street Railway Company has been incorporated to construct an electric railway from this city to Upper Alton. The directors are Manning Mayfield, H. C. Swift and E. G. Webster, all of Upper Alton.

BROOKLYN, N. Y.—The De Kalb and Franklin avenues street railway lines are to be changed from horse to electric power. Col. J. N. Partridge is the progressive president of the company.

New Electric Lighting Companies.

NORTH TONAWANDA, N. Y.—The Standard Electric Light and Power Company, Geo. P. Smith, president, has been incorporated to furnish electricity for light, heat and power for the towns of Wheatfield, Niagara, Tonawanda, Amhurst and Grand Island; capital, $100,000. Promoters, Geo. P. Smith, John D. Warren, Susan O. Smith.

PORTLAND, ME.—The Berlin Electric Light Company, H. R. Virgin, president, and Fred. S. Hall, treasurer, has been incorporated with a capital stock of $5,000, for the purpose of producing electricity for light, heat and power.

FENTON, MICH.—The Fenton Electric Light Company will erect a new plant.

KALISPELL, MONT.—Kalispell Water and Electric Company; capital, $250,000. Promoters, Jos. A. Coram, Frank E. Corbett, John B. Wellcome, all of Kalispell, Mont.

NEWARK, N. J.—The Ceramic City Light Company; capital, $50,000. Promoters, R. Arter, New Lisbon, O.; C. T. Harbaugh, S. E. Harbaugh, Sewickley, Pa.; C. M. McKeehan, W. H. Murphy, East Liverpool, O.; P. M. Smith, A. R. Wells, Wellsville, O.; W. F. Zimmerman, Newark, N. J. Incorporation papers sent to J. V. Bacot, Jersey City, N. J.

PORTLAND, ME.—Berlin Electric Light Company; capital, $50,000. Promoters, Henry H. Furbush, W. H. Furbush, of Berlin, N. H.; Harry R. Virgin, Fred. S. Hall, of Portland, Me. Incorporation papers sent to H. R. Virgin, Portland, Me.

EVANSVILLE, IND.—People's Electric Light and Power Company; capital, $100,000. Promoters, R T. McDonald, H. J. Miller, Brainard Rarison, Fort Wayne, Ind. Incorporation papers sent to C. C. Miller, Fort Wayne, Ind.

KNOXVILLE, TENN.—The Fountain City Land and Improvement Company contemplates the erection of an electric light plant at Fountain City, a Knoxville suburb.

YORK, PA.—A movement is on foot to organize a new electric light company under the Westinghouse system.

DULUTH, MINN.—The Hartman Electric Company, the Duluth Electric Light and Power Company and the Northern Electric Subway Company have been consolidated and reorganized under the name of the Hartman General Electric Company. A. W. Hartman, president; Charles R. Haines, vice-president; R. A. Costello, treasurer; C. E. Van Bergen, secretary.

SAVANNAH, MO.—An electric light plant will soon be put in process of erection and is to be completed as soon as possible.

MONTELLO, WIS.—The common council has voted to light Montello by electricity. Lights will be furnished by the Montello Granite Company, which already has put in a plant for its own use.

STAMFORD, N. Y.—The Stamford Electric Light Company has been organized, with a capital of $20,000, to furnish electric light, heat and power in Stamford. The directors are Isaac H. Maynard, S. E. Churchill, George H. Hager and J. K. Grant.

New Manufacturing Companies.

DECATUR, ILL.—The Pratt Electric Company, capital, $100,000, has been incorporated under the laws of Illinois. Incorporators, Elmer E. Gibson and Richard F. Pratt.

BERWICK, ME.—The Baker-Tyler Company; capital, $250,000. Incorporated to manufacture electrical and other devices. The directors are C. M. Rogers, H. S. Bacon and Wm. S. Tyler, of Worcester, Mass.; and H. B. Moore, of Berwick.

CHATTANOOGA, TENN.—J. E. Van Valkenberg will organize a company to erect electrical works. He has purchased the right to manufacture in Tennessee the lamps, batteries and motors of the Hubble Electric Light and Power Company.

LOUISVILLE, KY.—C. J. Jenne, William Carter and Charles E. Willey have incorporated the C. J. and W. Electric Company, to deal in and manufacture electrical machines, etc. The capital is $10,000.

KALISPELL, MONT.—Joseph A. Coram, Frank E. Corbett and John B. Wellcome have incorporated the Kalispell Water and Electric Company, with a capital of $250,000.

CHICAGO, ILL.—Electrical Development Company; capital, $1,000,000. Incorporators, Frank Weeks, Isaac H. Pedick and F. E. Hinckley.—The Jean Arc Light Spark Arrester Company; capital, $100,000. Incorporators, Charles W. Jean, Wm. E. Johnson and Wm. R. Hauze.

WEST STAFFORD, N. Y.—The Electroloid Manufacturing Company will operate a plant employing 50 hands.

New Telephone Work.

BALTIMORE, MD.—An endeavor is being made to reorganize the Drum Point Telegraph and Telephone Company, and secure the completion of the lines from Baltimore to Drum Point. Alexander de Barril, of Calvert County, is interested in the matter, and expects to organize the company in a few weeks. He says the telegraph and telephone companies in this city are disposed to assist the scheme and operate the city end of the line when completed.

Municipal Improvement Company.

NEW YORK CITY, N. Y.—Municipal Improvement and Investment Corporation (incorporated in W. Va.); capital, $500,000. Promoters, H. A. Holt, P. S. Swain, J. R. Turner. Incorporation papers sent to John Ferguson, 52 Broadway, New York city.

Heat, Light and Power.

CHICAGO, ILL.—Waukegan Heat, Light and Power Company, Chicago; capital, $100,000. Incorporators, John D. Cameron, James D. R. Graham and Calvin E. Brown.

SEATTLE, WASH.—Country Club; capital, $24,000, single share, $1,500. Construct, operate, own and lease street railways, both steam and electric, cable roads, steamboats, telegraph and telephone lines, electric light, gas and water works. Promoters, R. B. Albertson, Wm. E. Baily, Herman Chapin, Geo. R. Carter, Josiah Collins, E. B. Downing, Jno. R. Galt, Geo. H. Heilbron, L. S. J. Hunt, Wm. A. Peters, B. Pelly, Geo. H. Preston, R. C. Washburn, of Seattle, Wash. Incorporation papers sent to Strudwick, Peters & Van Wyck, Seattle, Wash.

BOISE CITY, IDAHO.—Payette Real Estate and Investment Company; capital, $25,000. Promoters, R. D. Watterbeck, W. S. Bruce, R. M. Boggs, B. W. Walker, P. C. Lellman. To handle electric light plants, water works and a general commission business. Incorporation papers sent to R. D. Watterbeck, Boise City, Idaho.

WEBB CITY, MO.—Webb City Light and Power Company; capital, $150,000. Promoters, W. C. Maybury, T. H. West, J. T. Davis. Incorporation papers sent to Edward Cunningham, Jr., care St. Louis Trust Company, St. Louis, Mo.

A New Firm.

HARTFORD, CONN.—Charles J. Reynolds and J. E. Spalding, both well known electricians of Hartford, Conn., have found a partnership for carrying on a general electrical business in all its branches. The offices of the new firm are located at 13 Haynes street.

Water and Electric Company.

EVERETT, WASH.—Everett and Lake Stevens Water and Electric Company; capital, $250,000. Promoters, J. J. Falstad, Geo. S. Brown, both of Everett, Wash.

Consolidation.

BINGHAMTON, N. Y.—A certificate of the consolidation of the Thomson-Houston Light, Heat and Power Company with the Binghamton Electric Company, forming the Binghamton General Electric Company, has been filed with the State secretary. The directors are George W. Dunn, James E. Shapleigh and James H. Roberts, of Binghamton; Frank Gould, of Oneonta, and Robert E. Drake and Paul T. Brady, of Syracuse.

BENTON HARBOR, MICH.—The Union Street Railway Company and the People's Electric Light and Power Company, of Benton Harbor, Mich., have consolidated under the title of the Union Electric Company, with a capital stock of $150,000. The incorporation papers were sent to Jas. L. Clark, Chicago, Ill.

A New York Electric Railway.

The Second Avenue Street Railroad Company has been granted permission by the New York Board of Railroad Commissioners to change its motive power from horses to electricity. A storage battery system will be adopted, and it is understood that the Waddell-Entz Company, 203 Broadway, this city, will equip the line. The Waddell-Entz storage battery has recently passed through very satisfactory tests and has received the commendation of well known experts.

The Edison Electric Illuminating Company, of New York.

The Edison Electric Illuminating Company, of New York, has turned over its installation or house wiring department and its sales department to the New York Electric Equipment Company, which has been organized with Mr. S. Bergmann as president and general manager, to take up this work. The general offices of the new company will be at 59 Duane street, adjoining the new Elm street central station of the Edison Illuminating Company.

The General Electric Company will build a new pump house, an addition to its porcelain works, and a new storehouse at Schenectady, N. Y.

KINDRED INTERESTS

The Cutter Electrical and Manufacturing Company, 27 South Eleventh street, Philadelphia, is sending out circular price list "B," of C-S specialties.

Julius Andrae of Milwaukee has made arrangements to represent the Central Electric Company of Chicago, in Milwaukee, and will carry a full stock of their goods.

The Standard American Electrical Company, whose offices are at 71 Broadway, this city, have taken a large factory at New Haven, Conn., and are now fitting up the plant for the manufacture of their apparatus. Machinery is being rapidly installed and they expect to be in running order in about 10 days.

New York Car Wheel Works, Buffalo, N. Y., have sent out a handsomely engraved folder describing their machined car wheels for electric cars. Each wheel is bored to a center, turned perfectly true on the tread and balanced. The New York office of the company has been removed from 115 Broadway to Bank and West streets.

The Thomson-Houston International Electric Company have removed their offices to New York. They will be located henceforth at 44 Broad street, in the Edison Building, where they will be more convenient for the transaction of foreign business. The post office address of the company will be 3067, New York. The offices formerly occupied by the International Company, in the New England Building, Boston, will be divided between the legal department and the patent department of the General Electric Company; reserving one or more back rooms for the stationary supply department. The purchasing department is enlarging its quarters, and the bureau of information has added an additional room. The newly organized auditing department, formerly upon the second floor of the Hathaway Building, Boston, is now removed to extensive and well lighted quarters upon the sixth, or top, floor of the New England Building.

The Sioux City Electrical Supply Co.

has added $12,000 to their paid-up capital.

They are now operating a Brass Foundry, making a specialty of casting electrical goods, but also casting copper, lead, zinc, tin, aluminum and antimony; making solder, babbitt, commutator bars, etc., for the trade.

$4,400 CASH

Buys a stock of Electrical Supplies, good will of business, present contracts, etc., if taken at once. Business established in growing town of 3,500. Goods alone inventory $4,600, market value. Copy of inventory confidentially furnished on application. Address,

"BUSINESS,"
ELECTRICAL REVIEW, 13 Park Row, N. Y.

THE DANDY BELL.

Best Bell, pressed metal gong, long phosphor bronze springs and platinum contact points. Most reliable bell in the market. In four sizes, 2½ inches, 3 inches, 3½ inches and 4 inches. Samples sent post-paid to all dealers upon receipt of 50 cents and business card.

THE TIME ELECTRIC CO.,
C. C. BARTLETT, Gen. Manager,
CLEVELAND, O.

ROYCE & MAREAN,
DEALERS IN
ELECTRICAL APPARATUS,
Telegraph and Telephone Supplies,
No. 1408 Penna. Avenue,
Opp. Willard's Hotel. WASHINGTON, D. C.

MACHINERY IN STOCK.

Engine Lathes, 10 in. x 4 ft.; 11 in. x 5 ft.; 12 in. x 6 ft.; 14 in. x 6 ft.; 16 in. x 6 ft.; 18 in. x 8 ft.; 20 in. x 8 ft., with tapes attachment; 22 in. x 12 ft. and 14 ft.; 24 in. and 26 in. x 16 ft.; 30 in. x 10 ft. and 18 ft.; 36 in. and 38 in. x 20 ft.; 42 in. x 12 ft.; 27 in. x 32 ft.; 88 in. x 31 ft.; 96 in. x 20 ft. Fox Lathes, 13 in. x 5 ft.; 14 in. x 5 ft.; 15 in. x 6 ft.; 18 in. x 6 ft. Turret Lathes, 12 in. x 5 ft.; 14 in. x 5 ft.; 15 in. and 16 in. x 6 ft.; 18 in. x 6 ft.; 36 in. x 8 ft.

Planers, 16 in. x 16 in. x 3 ft.; 20 in. x 20 in. x 4 ft.; 24 in. x 24 in. x 6 ft.; 30 in. x 30 in. x 6 ft.; 36 in. x 36 in. x 10 ft.; 42 in. x 42 in. x 12 ft.; 44 in. x 48 in. x 22 ft.; 60 in. x 49 in. x 24 ft.

Friction Shapers, 15 in., 16 in., 20 in., 22 in., 32 in.

Crank Shapers, 6 in., 8 in., 10 in., 12 in., 13 in., 16 in., 17 in., 20 in., 24 in., 28 in.

Screw Machines, Nos. 1, 2, 3, 4, with or without Wire Feed.

Screw Machines, Nos. 5, 6, 7, 8, Power Feed.

Presses, Nos. 51, 52, 53, Ferracute; Nos. 1, 2, 3, Stiles & Parker.

5 Lincoln Pattern Millers, No. 2.

Hand Millers, Nos. 1 and 2. 3 Cam Cutters.

Bolt Cutters, ¼ in. to 1 in., ½ in to 2 in.

2 Profiling Machines. 1 36 in. and 48 in. Gear Cutter.

C. D. and E. Horizontal Boring Machine. Newark Machine Tool Co.

Send for List of New and Second-Hand Machinery in Stock.

PRENTISS TOOL & SUPPLY CO., P. O. Box 3362, 115 Liberty Street, New York. 59 South Canal St., Chicago, Ill.

Something New! One, two, three, and four spindle drills for light work.

DRILLS

The most useful patented improvement in drill presses for years is applied.

SENSITIVE

Spindles driven with single, endless belts. Large driving pulleys, tightener and variable speeds provided.

Over 1,000 in use. Buy the **latest** and **best.** Special machinery to order. Catalogue of finished tools free.

Dwight Slate Machine Co

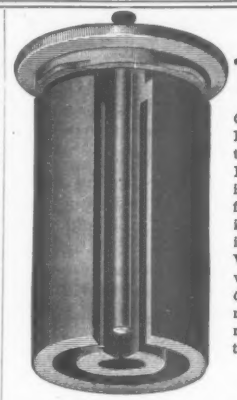
STAMFORD, CONN.

ALUMINUM!

THE COWLES ELECTRIC SMELTING & ALUMINUM COMPANY,
Lockport, - New York,

Offer Pure Aluminum in Ingots, Slabs, Sheet, Wire and Castings at lowest market rates.

Aluminum Bronze, Aluminum Brass, Silver Bronze, Silicon Bronze and Manganese Bronze.



THIS is a cut of the Law Battery Double Cylinder Carbon Element attached to cover with zinc. It has 147 square inch carbon surface. The element is everlasting and is so guaranteed. Why use a battery with a chemical depolarizer that needs frequent renewal of the negative element?

LAW BATTERY COMPANY,
85 JOHN STREET, N. Y.

ROBB MACKIE,
Consulting Electrical Engineer,
NEAVE BUILDING,
CINCINNATI, O.

Professor Dolbear's NEW BOOK.

"Matter, Ether and Motion."

PRICE, $1.75.

This is a highly interesting and timely work by Prof. A. E. Dolbear, Prof. of Physics Tufts College, author of "The Telephone," etc. The book consists of 330 pages, is abundantly illustrated, and should be in the library of every electrical worker

Address,
ELECTRICAL REVIEW,
13 Park Row, NEW YORK.

THE GRAVES ARC LAMPS.

FOR ALL CIRCUITS. HIGH AND LOW TENSION.
BEST AND CHEAPEST. WRITE FOR PARTICULARS.
DON'T PURCHASE UNTIL YOU SEE THEM.

GRAVES TRANSFORMERS are the lightest in Weight and highest in Efficiency.

The W. D. GRAVES Electrical & Manufacturing Company,
CLEVELAND, OHIO.

GENERAL ELECTRIC CO.

MAIN OFFICES:

620 Atlantic Avenue, BOSTON, MASS. | **44 Broad Street,** NEW YORK CITY.

BRANCH OFFICES:

620 Atlantic Avenue, Boston, Mass.
173-175 Adams Street, Chicago, Ill.
Gould Building, Atlanta, Ga.
264 West Fourth Street, Cincinnati, O.
44 Broad Street, New York.
509 Arch Street, Philadelphia, Pa.
Masonic Temple, Denver, Col.
401-407 Sibley Street, St. Paul, Minn.
15 First Street, San Francisco, Cal.

AN ELECTRICAL LIBRARY.

OPPORTUNITY FOR BEGINNERS.

A Comprehensive, Carefully Selected, yet Inexpensive, List of Instructive Electrical Books.

In response to the many inquiries from all parts of the country as to the best books for those who are desirous of becoming posted in the rudiments of Electricity in its various branches, and in an endeavor to afford beginners as wide a range of reading as possible for a comparatively small outlay, the Book Department of the **ELECTRICAL REVIEW PUBLISHING COMPANY** makes the following offer:

We will send by *express, prepaid,* on receipt of **$15.00,** fourteen books by the most popular authors, especially adapted for a course of elementary reading, including the **ELECTRICAL REVIEW** for one year, as follows:

PRACTICAL ELECTRICITY, - By *Ayrton*
ELEMENTS OF ELECTRIC LIGHTING, - - - - By *Atkinson*
DYNAMO TENDER'S HAND BOOK, By *Badt*
INCANDESCENT WIRING HAND-BOOK, - - - - By *Badt*
THE DYNAMO, - - - By *Bottone*
ELECTRIC BELLS AND ALL ABOUT THEM, - - By *Bottone*
ELECTRICITY FOR ENGINEERS, By *Desmond*
THE TELEPHONE, - By *Dolbear*
ALTERNATE CURRENT MACHINERY, - - - - - By *Kapp*
INCANDESCENT ELECTRIC LIGHTING, - - - - - By *Latimer*
A, B, C, OF ELECTRICITY, By *Meadowcroft*
ELECTRICITY SIMPLIFIED, - By *Sloane*
ELECTRICIANS' PRIMERS (Theory and Practice), 2 Volumes.
ELECTRICAL REVIEW, - ONE YEAR (52 Numbers.)

The price of the above list is $18.00, *and, aside from the saving on cost, the student has the benefit of an unexcelled selection from which he can derive the best practical results.*

REMEMBER: $15.00 buys all of the above, delivered to your office or residence.

Address:

ELECTRICAL REVIEW,
13 Park Row, N. Y.